TEACHERS' MANUAL FOR

Science Every Day

CRAIG AND BALDWIN

OF SCIENCE

TEACHERS' MANUAL FOR

Science Every Day

By Gerald S. Craig

Professor of Natural Sciences
Teachers College, Columbia University

and Sara E. Baldwin

Director of Reading Program
State Teachers College
West Chester, Pennsylvania

Ginn and Company

Boston · New York · Chicago · Atlanta · Dallas · Columbus
San Francisco · Toronto · London

546.10

The Athenæum Press
GINN AND COMPANY · PROPRIETORS · BOSTON · U.S.A.

CONTENTS

TEACHERS' MANUAL FOR
Science Every Day

FOREWORD: OUR WORLD OF SCIENCE

"It is no longer possible for us to ignore science in the elementary school if we are to discharge our full responsibilities as teachers," a superintendent of schools said recently to his teachers. In these words he expressed the view of thousands of parents in the United States who have become convinced of the great power of science in this modern world.

Unquestionably teachers in the elementary schools wish to meet the growing demand for science. But many of them are hesitant about teaching science because they recognize a weakness in their own background. The basal books in the series Our World of Science and the accompanying Manuals have been written to meet the needs of classroom teachers, whether they have had previous training in science or not. The program of science presented in this series is one in which teachers can learn science with their pupils.

Reasons for Teaching Science

A moment's reflection is sufficient to indicate that there is no part of the elementary-school curriculum that has more important contributions to make to the present and future welfare of the nation and of the world than has science. In the following paragraphs are discussed briefly a few of these contributions.

Science makes it possible to abolish poverty. Geologists have learned a great deal recently about how to explore the earth for basic material resources. In cases where raw materials for some substances are scarce, chemists have learned ways of making synthetics which will serve all the purposes required of the original substances. This is illustrated in the manufacture of synthetic tires and quinine, for example. Chemists strive to make new substances from raw materials that are found in abundance, such

as clay, farm produce, and coal tar, thus providing new substances at a very low cost. In this way industry is promoted, more people are given employment, and the new materials are made available to increasing numbers of people. Will the children in our classrooms be prepared to utilize wisely the great material resources of the earth?

Science makes it possible for us to eliminate backbreaking toil. A few years ago most of the work of the world was done with muscular energy. Today we have learned to harness vast stores of energy to machines that may be operated by the pressing of a button. These laborsaving devices can be used in our homes, in factories, and on the farm. Tasks which took hours or days to accomplish can now be completed in a simple operation, and thus more hours are provided for recreation. Will our children be equipped to make intelligent adjustment to the vast supplies of energy and new laborsaving inventions which are daily being made available?

Science makes it increasingly possible to improve the health and safety of the peoples of the world. One of the tasks of the children in our classrooms will be to see that the discoveries of the scientist make a life of good health and freedom from accident available to all.

Science makes it possible for hunger to be abolished. Many authorities contend that an ample supply of food can be raised for all the people of the world by using the improved methods of agriculture which have been discovered in recent years. There is, however, a grave danger that humanity will face increasing periods of famine if it does not soon learn to save its great soil resources. Will our children have the vision to plan for an ample world food supply, or will they through ignorance cause new periods of famine?

Everywhere we turn we see science offering to humanity a higher standard of living in the form of improved food supply, recreation, transportation, communication, and health for all. This improvement, secured on a world-wide basis, would eliminate the chief causes of rivalry between nations and would help to promote permanent world peace.

The United States, as a result of recent events, has assumed a unique responsibility for world leadership. American children must be encouraged to have high ideals of service to humanity, and they must know how to put their ideals into operation on a democratic basis. They must be made to realize the responsibilities and opportunities that are theirs because they are Americans. They must discover while they are young the importance of science and must learn how it can be used to promote world welfare.

The record of the past indicates many fatal errors. Depressions, wars, destruction of valuable soils, pollution of streams and waterways, wastage of mineral resources, introduction of crop pests, have left their mark. With them have come needless poverty and ill health. The elementary school today is responsible for the development of a generation that will be wiser than past generations. Children must learn to realize the power that man has secured through science for the development of a civilization superior to their own.

The task, then, of the elementary teacher in teaching science is clear. Failure on her part to open up the avenues of science to the natural drives of children may result in citizens of tomorrow who are poorly prepared for the adjustments and responsibilities of the atomic age.

The Use of Books in the Teaching of Science

As much as possible the teacher should work with the children while they work, read with them while they read, discuss matters when they discuss them. In other words, the teacher should be a member of the group, learning with the children in a natural situation instead of watching their activities as a bystander or outsider. In all this work the basal book in science can lead to dynamic motivation and vitality of instruction.

The Development of an Informal Working Situation. An informal working situation in teaching science brings good results. It provides an opportunity for children to express their own ideas and to develop lines of interest.

This need not be interpreted, however, as a loose and undisciplined procedure. Science in itself has its discipline, which grows out of the scientific method and attitudes, and the teacher[1] should be keenly aware of the relation of method and attitudes to desirable social behavior in children. If this awareness is applied in science teaching, the teachers of a school should discover, in the work from the first grade through the eighth, a marked improvement in the ability of children to work together on problems.

In the teaching of science both teacher and children should feel relaxed. Much of the austerity found in American classrooms grows out of pressure and haste, which are not in keeping with the rhythm and tempo of child life. If the teacher will remember that the very nature of science calls for discovery and open-mindedness, she will lose the fear of admitting an error in her own thinking. She need have no reluctance in stating frankly that she is learning with her pupils and that there are many things she does not know. The true scientist is learning when he is making discoveries.

Reading in Science Teaching. Reading in the science book should lead to other types of activities, such as discussion, performing an experiment, and planning a science excursion. These activities in turn will cause the children and teacher to go back to the basal book or to supplementary material for information and for new interests and subjects. Many teachers find oral reading useful in science teaching.

As much time as is needed should be taken to clear up each thought. The teacher should allow the child to work important ideas found in the basal books into his thinking through the use of such basic drives as curiosity, imagination, and manipulation. The use of children's natural drives need not place the teacher in an embarrassing position, since in an informal teaching situation children can help one another.

It should be noted that this kind of work does not call for rapid reading. In fact, it may mean slow reading, with much

[1]Gerald S. Craig, *Science for the Elementary-School Teacher*, pp. 13–19, 30–36. Ginn and Company, Boston, 1940.

consideration of a single sentence, paragraph, or page, and the relating of content to the children's observations and experiences. The way in which children should use books in science is quite different from the way in which they read a book of fiction, such as a storybook. In science one is seeking truth, and truth is not secured through superficial reading.

Discussion and the Use of Basal Books. Discussion in science can grow out of the use of books. A child or the teacher may have a question about something that has been read. There may be an incident which a child or the teacher wants to add to illustrate a point. Someone may attempt to explain a statement or to add more content to make a point clear. Another may propose the making of a sketch or other art work to illustrate a point. In all this, books will serve to stimulate discussion. Basal science books will be useful also in checking the accuracy of the discussion.

A discussion may last only a few minutes, or it may profitably continue for some time. Teachers should strive toward the improvement of discussion; with younger children discussion is fragmentary and impulsive; with older children it may be characterized by high qualities of critical-mindedness and intelligent planning. Children can secure no small training in learning to discern the difference between reliable and unreliable information as a result of science education in the elementary school.

In teaching science we are concerned primarily with how to find the truth. The process of finding the truth is one that the teacher must share with the children. An authoritative book in the hands of a child serves to assist both him and the teacher in discovering the truth. The teacher should ask from time to time such questions as these: "How can we find out? Are you sure? How can we get the answer? Can you prove it? Why do you say that? How much of what you said is true? What does it mean to you?" It is to be noted that the teacher's primary task is not to answer questions but to help the children find the solution.

Experiments and the Use of Basal Books. Children in the elementary school should become aware of the meaning of experi-

mentation. Our World of Science is filled with suggestions of experiments which can safely be performed by children with equipment that can be obtained in any community. An experiment should be seen as something more than a funny trick or magic. Attention should be focused on what the experiment is to prove. Discussion forms an important part of experimentation in science. It is frequently wise to repeat experiments. Finally, the conclusions developed through the use of experiments should be checked with authoritative books whenever possible.

Field Excursions and the Use of Basal Books. At all times the content of the book should be closely related to what is going on in the community. One means is the field excursion. A field excursion may be short or long, depending on its purpose and the locality to be visited. Sometimes a trip may be made to the heating plant in the school basement, to the fuse box, to a fire extinguisher in a near-by hall, to some vantage point to observe the change of seasons, or to a suitable place to observe the clouds and weather changes. It frequently is advisable to make a trip again after an interval in order to note changes. This is particularly true in studying seasonal changes or the procession of weather changes.

Vacant lots, quarries, gravel pits, road cuts, plowed fields, meadows, woods, orchards, barnyards, are particularly good places for observation. The study of construction work, such as that of new buildings or new highways, power lines or telephone lines, provides opportunity for observation for children at all levels. Then, too, the work of the custodian or janitor of a school building has its scientific aspects, which give children opportunity for useful observation. How the various services, such as water, gas, telephone, electric power, enter a building is usually fascinating to children. In this work the janitor can be of valuable assistance to the teacher and children.

Children may need to collect material on a field excursion. This should be done only with a sensible view of conservation in mind. One of the most important meanings of science is the wise utilization of materials—conservation. Plants and animals

should not be brought into the classroom unless they are to be studied and cared for properly.

It is not necessary that the teacher be able to identify the various plants and animals by name in order to conduct a successful excursion. Many good field excursions have been conducted in the elementary school with only a minimum of identification. As a matter of fact, very few scientists or naturalists are capable of identifying exactly a wide range of objects.

New Challenges Needed from Time to Time. While emphasis has been placed on thoughtful rather than on rapid reading, the teacher should be on the alert to see that the work proceeds at a pace challenging to the children. One way to accomplish this is to move on to new aspects of the subject under consideration or to new subjects. A function of a good science book is to provide new, challenging, and vital subjects for children. Careful observation of the behavior of children will give the teacher indications of whether the children are ready for new material.

Science for All the Children

This discussion suggests how important it is that everyone in a democracy, whether scientist or layman, should have an understanding of the place of science in society. Science is a powerful tool which can be used for good or for evil. If democracy is to survive, the common people must become aware of the potentialities of modern science in a world community. To produce this awareness seems to be uniquely a task for the elementary school, since the elementary school is the school of the people. The teacher, then, will need to make certain that science is made to function in the thinking of all the children. In this way the elementary-school teacher becomes an important factor in the destiny of our nation and the world.

GERALD S. CRAIG

Science Every Day is designed to meet the needs and the abilities of children on a third-grade level. The science concepts have been chosen with this age group in mind. The organization of content, the vocabulary, the structural development, and the illustrations have been worked out as nearly as possible from the standpoint of eight-year-olds and nine-year-olds.

This book is essentially a science book and should be used as such. Whereas every attempt has been made to provide reading matter that is interesting and easy, the book is more than a reader. It is a "doing" book. It is intended to increase children's eagerness to learn about the world around them, and it encourages them to do something about their science experiences.

Meanings Grow through Activities

For such growth one does not depend upon reading alone. Various other kinds of activities, together with reading, are the means by which children find out about their world and learn how to adjust themselves to it. These "other kinds of activities" consist of such enterprises as observation, excursions, experiments, discussion with classmates, investigation of the opinions of authoritative persons, and other means of clarifying, verifying, and enriching information. At some place in each unit in this Manual the use of one or more of these activities has been described in detail.

Children's growth of understanding in the realm of science is promoted also by the arrangement and equipment of the classroom itself. Almost any and all parts of the room may be utilized to make learning realistic. Your bulletin boards, a table or two, window sills, bookcases, and shelves, all provide space for materials that you will want to use. Even the windows should be utilized to this end, for you will want to look through them to observe weather conditions or perhaps to watch construction activities going on outside.

Your equipment and materials need not be elaborate or expen-

sive. At the end of each chapter in the Manual there is a list of the equipment needed for that portion of the pupils' study. You will need to prepare also for such general equipment as visual materials or exhibits, science table for experiments, and visual aids, such as films and slides. You will need to consider ways for making bulletin-board displays an interesting and active part of your program.

Visual Materials. Children are natural collectors. Every teacher is familiar with the miscellany of rocks, shells, seeds, bright-colored leaves, turtles, salamanders, cocoons, bulbs—an endless variety of objects—which find their way into the classroom. Most of these are brought in by children who have a conscious interest in them. Children should be encouraged to bring in objects dealing with science by having a suitable place to dispose of the object upon its arrival.

Some objects can be put into a class exhibit. Seeds, seed pods, leaves, and rocks can be displayed in a well-organized fashion. At first you may have only a window ledge to be used for this purpose. But as time goes on, you probably will need more space, where objects can be displayed to better advantage. The children may wish to build a display cabinet of their own, or the janitor may be able to find some old shelves which have been stored away. Even the much-abused orange crates can be brought into use.

Activities such as identifying, labeling, describing, and arranging objects in these exhibits are among those which children find worth while. Desirable attitudes develop as children show their exhibits to children in other rooms or to mothers and other classroom visitors.

Of course bulbs should be planted. Cocoons should be placed in an insect cage or in some place which will properly accommodate the adult insect when it emerges from its pupal state. The salamanders and certain other small animals should be placed in an aquarium or a vivarium. These are described on page 34 of the Manual.

It must be understood that these exhibits vary greatly in permanence according to the interests of the group and according to

the appropriateness of the display. Exhibits of seed pods or autumn leaves are temporary and will stay in the classroom only a short time. Some exhibits, as of certain animals, may stay in the classroom for a day or so, but should be returned to their native habitat as soon as possible. Still other objects, such as a well-labeled rock collection, are of a more permanent nature and will tend to have a more permanent place in the school.

Materials for these exhibits should be collected only with a true interest in conservation on the part of both the teacher and the pupils. Help the pupils to learn not to be wasteful about the materials which they bring to school.

If you have the good fortune to be teaching in a school that is near a state or city museum, you will want to familiarize yourself with the opportunities offered there for your program of study.

Many museums maintain loan exhibits. State museums as well as local museums offer this service. Many museums also have a film and slide library which you are welcome to use.

Some museums and most public libraries have collections of pictures dealing with various topics. All these loan collections are excellent supplementary teaching materials.

Science Tables. Materials of science must be accessible for children to use. Children must have some place where they can work and experiment without anyone's being worried about the disorder or the slight damage which may result. A science table seems to answer this purpose in many classrooms.

Such a table may be a rough work bench which the children themselves have constructed, or it may be an old table which has been brought out of storage by the janitor. In the latter case it may be necessary to have a few inches sawed off the legs in order that the table may have the correct height for the children to use comfortably. At any rate it should be the sort of table that will not be harmed by spilled water or the contents of a dry cell or by the scratching of rough objects which have been placed upon it.

What belongs upon this table depends upon the activity which the children are working out. At one time the table may be holding an assortment of dry cells, some bell wire, an electric bell,

and so on. This will give children opportunity to experiment freely with electricity. At another time the table may be a place where an aquarium is being cleaned. Here there is room for plants, siphon, and whatever other articles are needed for the enterprise.

The science table should be a place where children can leave materials with which they are experimenting. The teacher should not be distressed about the matter of orderliness of the materials if they are really being used. When there is no further use for any particular material, it should be put away to make the space available for other work materials.

Visual Aids. Methods of teaching service men in the Second World War have shown how eye-minded most people are. Many teachers have found that pictures teach easily, accurately, and quickly. Their use in supplementing other methods of teaching is invaluable. Motion pictures supply a real need in modern teaching.

Most state departments of education now have made some start upon a film library. You can write to your state department to find out what it has to offer in this field. If there is a catalogue, this should be a part of your equipment. You should also be familiar with the steps necessary for obtaining films and other visual-aid materials from the state department. Many state universities also provide these materials.

The Federal government maintains a visual-aids service. Here again the teacher should have as part of her equipment the catalogues and leaflets which furnish information for this purpose.

Bulletin Boards. As you continue to teach science to children, you will find yourself collecting many things. You will collect pictures and clippings among other things. You will search through magazines, you will write to commercial companies, you will examine articles in newspapers and magazines for pictures and for written materials that relate to subjects which you are studying. With a little encouragement your pupils will share your enthusiasm for this form of collecting and may appear with surprisingly interesting and appropriate materials. The bulletin

board is a place where these many supplementary materials can be exhibited to best advantage.

The bulletin board lends itself to many kinds of uses. At one time it is a place where current happenings in science are posted. At another time it may hold reports written by various members of the class. Many times it is concerned with only one large interest, and its space is given over to pictures, clippings, and drawings dealing with that topic. At other times it is a miscellaneous collection of science materials.

A good bulletin board reflects the interest of both teacher and pupils and the time applied to a given subject. In order to have a bulletin board that really works, both teacher and pupils must assume responsibility for its preparation.

A good bulletin board requires at least two forms of effort—well-selected materials and good organization. Materials should be displayed with the same recognition of relative importance as when objects of merchandise are displayed in a show window. Do not try to display too much at one time.

Above all, use the same judgment that is used in the other forms of exhibits previously mentioned. Change the exhibit as soon as its usefulness is over. A blank bulletin board is better than an outmoded one. This may even serve as a point of departure for a new display because the pupils probably will ask, "Why is nothing on the bulletin board today?"

In these ways, then, your classroom is at work in the teaching of science.

Individual Differences of Children

Thus far we have been considering equipment from the standpoint of physical things, of inanimate objects. What about the equipment of the children themselves?

The children of your third grade are not equally well equipped to learn. Some grasp science meanings much more quickly than others. Some children read more rapidly and with more comprehension than others. Some children are able to do this because they have a higher degree of native intelligence than the others have. Other children excel because they have greater interest

and more natural aptitude for the subject. What are we to do about these individual differences?

First of all we must be aware of them. We must not expect similar interest and response from all children. We must know how to go slowly with the immature children. We must be exceedingly alert to provide the mature children with additional activities which are adequate to their needs. Suggestions for handling individual differences of children are given in this Manual on pages 30, 31, 37, 67, 68, 72, and 89. These suggestion may be adapted to other units of work.

Helping the Teacher to Help Herself

Are you one of those teachers who hesitates to teach science because she feels that she does not know enough about it? This Manual is planned to give you help and confidence. Its principal purpose is to guide the study of the children's textbook and to help you to carry out other learning activities. The Manual aims also to extend your background of information and to give specific help in enriching your methods of teaching science. In addition to the information offered in the Manual, a short bibliography, listed at the end of each chapter in the Manual, gives sources of further help in building up knowledge in science. Study also the children's references. These too will help to increase your fund of knowledge about science.

If you have a substantial background of science, you are fortunate indeed. If your background is limited, a joyful experience is before you—that of learning *with* your pupils. Working in science with your pupils should help you to have a better understanding of children's growth in learning and to enjoy with them the thrill of "finding out" in Our World of Science.

At a very early age most children express interest and wonder as they observe the sky above them. They often cry out with delight when they see the bright full moon or a sky full of stars. They talk about clouds in the sky. They like to play in the sunshine.

Children ask many questions about the "things" they see in the sky. They listen eagerly to explanations offered in response to their questions. The teacher has a significant responsibility in guiding the thinking of children. Her challenge here is to help them to learn more about the vastness of the universe. The children's concepts of space will grow and grow with the years as they meet new experiences.

Children who are of an age to read *Science Every Day* usually want to find out for themselves the answers to many of their questions. They are ready to observe, to read, to study in many ways about the phenomena of heavenly bodies. In guiding children's study, emphasis should be placed not upon their memorizing the subject matter but upon their making adjustments to the universe in which they live.

PURPOSES

This chapter is designed to further in pupils a growing consciousness of the influence of the sun upon the earth and all living things.

It also develops some understanding of the moon and its relation to the earth.

Among the learnings which should emerge from this study are the following:

There are many differences between day and night. These differences have an effect upon living things.

The heavenly bodies are real.

The moon is a real place—as solid as the land part of the earth.

The heavenly bodies are far, far away from the earth.

The universe is very, very large.

GUIDING PUPILS' STUDY

"Day Sky and Night Sky" is designed in such a way that the beginning pages open up problems for children to think about. You will want to discuss some of these problems later on, after reading has taken place; but the children's first interest in the subject of heavenly bodies will be stimulated by what they find in the beginning pages of their book.

Pages 5–10. "Morning" through "End of Day." To achieve best results, children should take plenty of time for reading these pages. Whereas the concept of the changing position of the sun throughout the day seems very simple to us, it is an amazing phenomenon which challenged the minds of scholars for hundreds of years. We need to give children time to consider the idea that the earth's turning makes the sun appear to cross the sky. Help the pupils to interpret the concepts represented in the pictures in their book.

Time is well spent in discussing pictures relating to the subject matter. We must realize that pictures are not in themselves instructional. Pupils do not always study them, nor do they always see the significant features without the teacher's guidance.

Study the picture on pages 4–5. Talk about what is happening in the picture and compare these details with the pupils' own observation of a sunrise.

When you are ready to read, remember that a motivating question or comment helps children to read with a purpose. In this instance an appropriate suggestion to the children might be, "Read to find out how the out-of-doors changed in this story as the day went on from sunrise to sunset."

Many teachers will find that the attention of the group will be held to the purpose by having these first pages read aloud. At the beginning of each page, pause long enough for pupils to take a good look at the picture. At the end of pages 7, 8, and 9, questions are asked. The pupils should have the opportunity to answer these questions to their satisfaction.

After reading pages 5–10 there should be opportunity for discussion of situations in which the children have noted the chang-

ing position of the sun throughout the day. You can encourage such discussion by setting up problems such as the following:

We have the light turned on in our schoolroom in the morning. Later in the day the sunshine in the room is so bright that we need to pull down the shades. What makes this happen?

The playground is cold and wet when we come to school in the morning. Later on when we go out to play, it is dry and warm. Why does this happen?

After reading this part of the chapter the pupils may be interested to find out where the sun appears to be in their own town at the times mentioned in the story. They may discover, for example, that at school time it is just over the post office. Later on in the year, they may notice that the sun no longer seems to be over the post office at school time. It may be farther north. That will bring up new questions, which can be answered as the occasion requires.

As these pages are read, the children will also note the fact that the day grows warmer as the sun climbs higher in the sky. Let them compare the situations in the book with their own experiences. More than one child has lived through the following experience:

In early fall or late spring the mornings are cool. Long shadows fall across the streets. The children wear light coats or sweaters to school. By noon, the sun is so warm that the children do not need to wear the coats or sweaters and some of them may heedlessly leave their wraps behind. Later in the day, the lengthening shadows and cooler air will remind them of the forgotten coat or sweater.

Something will be gained by encouraging children to relate incidents which show that they have found shade or shadow to be much cooler than the sunshine.

Some children may state that in summer they always take the bottles of milk into the house as soon as possible after the milkman calls so that the milk will not stand in the hot sun.

On cold autumn mornings the children will see frost on the ground. Many will notice the fact that frost covers some places on the ground but that in other places no frost can be seen on the grass and sidewalks. See if they realize that the frost stays where the shadows remain longest. Similar worth-while experiences frequently are reported by children.

You will need to be mindful of the fact that it is the earth's motion and not the sun's motion which makes the sun appear to move across the sky. In discussing pages 5–10 with the children you may wish to bring out this point. The following analogy usually clears up children's questions in regard to this new concept:

When you ride on a train and look out of the window, the trees and telegraph poles seem to be moving past you. You do not see your train moving. Instead, the objects around you seem to be moving and in the opposite direction. So it is with the earth and sun. The sun seems to be moving from east to west, but the real movement is the earth's. The earth turns around and around from west to east.

Pages 11–12. Night. Children raise many queries and make some guesses about the sun. Of course haphazard guessing is an uncertain means of reaching a correct conclusion. But there is a certain kind of guessing that is very useful. This kind of guessing is in reality the drawing of inferences which are based upon reliable data. You build upon an hypothesis. You then follow it through to see if it is correct. This is one form of constructive thinking.

Try to build up a classroom atmosphere in which your pupils do not hesitate to voice an opinion. If they are honestly and sincerely projected, all opinions and conjectures should be seriously considered. You can help your pupils to learn that there is a difference between conjecture and fact and that they should seek to verify their conjectures.

Children often ask, "Where does the sun go at night?" This should stimulate lively discussion. You probably will need to offer information here. Your discussion should lead to the following conclusion:

The sun does not go anywhere at night. The sun is always shining, whether we can see it or not. We have day when the sun shines upon our part of the earth. We have night when the sun does not shine upon our part of the earth.

You can say this in another way: "Day is *where* the sun is shining upon the earth. Night is *where* the sun is not shining upon the earth."

In discussing day and night with your pupils, you will remember that the emphasis is upon two things—the difference between day and night and the influence which day and night have upon living things. The book makes no attempt to explain the cause of day and night. That concept will be developed in Book IV of this series.

Meaning will be increased by giving the pupils an opportunity to tell about things that happen at night other than those which the book has mentioned. Let them tell all the ways they know in which night is different from day and vice versa.

Ask the children if they know of other animals which prowl about at night and sleep in the daytime. Owls, nighthawks, and nightingales are some of these animals. Let the children tell how they know that mice are awake at night. Have them tell also what they know about work which is carried on at night.

Pages 13–16. Sunlight and Shadows. In reading these pages, motivating questions serve a good purpose. Help the pupils to raise such questions as the following, and read to find the answers:

What makes a shadow?
Why does the length of shadows change throughout the day?
Why do shadows not always point in the same direction?

With pupils of this grade level, confusion can be avoided by finding the answers to but one of these questions at a time.

Study the pictures carefully. They have been chosen to aid you in teaching. Let the pictures do their part in answering the children's questions.

The pupils will also need adequate opportunity to answer the questions asked in the book. Be sure that you give them time to do this.

There are a number of experiences that will help to make this concept of sunlight and shadows more meaningful. You can put up a shadow stick in your schoolroom or somewhere on the school grounds. Watch to see how the shadow moves during the day. Use some kind of marker to show where the shadow is at 9:00 o'clock in the morning, at 12:00 o'clock noon, and at 2:30 in the afternoon. If you measure the length of the shadow at each of these times, the pupils will have an opportunity to judge for themselves at which hour of the school day shadows are longest or shortest. While you are doing your measuring, note the position of the sun in the sky.

The children will be interested to realize that many people who do not have watches tell the time of day by the length of shadows. Long before clocks were invented sundials were used to tell time. The children may find it meaningful to make a sundial out of their shadow stick.

You and the children can have real fun with the shadows in your classroom. Find a shadow which is made by a plant or some other object placed in a window. Lay a book or some other small object on this shadow so that it is completely covered by the shadow. Try to keep this object fully in the shadow throughout the time that the sun shines through the window. The children may be quite surprised to discover how often the object must be moved because of the moving shadow. This helps them to realize how rapidly the sun's position in the sky is changed.

Watch many kinds of shadows out of doors. Note the time of day when the playground has most sun. Find out why this is so.

The children will enjoy playing shadow tag. Ask them what time of day this game is most exciting to play. See if they can tell why. Some children will like a time of day when shadows are short; others will prefer a time of day when shadows are long.

Watch the shadows made on the earth by clouds. Bring out the fact that cloudy days are dark because clouds cast a shadow over the earth.

Pages 17–23. The Changing Moon. The shortening days and early evenings of autumn bring the night sky into the conscious-

ness of children more vividly than it has been during the summer months. Moreover your pupils will now have become increasingly aware of the changes in the appearance and position of the sun throughout the day. The moon too has changes.

Good motivating questions for the reading of these pages will present themselves. One direct approach might be, "Read to see how the appearance of the moon changed as Mary watched it during one month."

The pupils' reading will be made meaningful if they pause at the end of each page to answer the question asked on that page. They may also raise further questions as they go along. Encourage them to ask questions. Study the pictures to note the changing shape of the moon and its position in the sky. If it is not mentioned in the text, it might be interesting for the children to figure out the approximate hour of the activity shown in each picture.

As the pupils read pages 17–21, some of them may notice the fact that on pages 17 and 21 the moon is fairly high in the sky and that on pages 18 and 19 the text indicates that the moon is just coming up. A discussion of the position of the moon in the sky at the various hours indicated in the story should result in the pupils' realizing that the moon not only rises in the east and sets in the west, like the sun, but also that it is not in the same position at the same time each night.

The children will notice, too, that the moon does not always rise at the same hour. During part of each month the moon rises in the daytime, so that when night comes, the moon is already high in the sky or on its way to setting. During another part of the month the moon rises at night. The reason is that the moon revolves around the earth from west to east once a month. If your pupils will observe the moon for a few evenings at the same hour, when the moon is shining, they will notice that each evening the moon has moved considerably toward the east from the position it held the evening before.

The *apparent* motion, or rising and setting, of the moon, like that of the sun, is due to the earth's rotation on its axis from west to east; but the daily change of the moon's position eastward is

due to the moon's revolution around the earth. If your pupils will observe the moon for several evenings during that part of the month when it rises in the east at night, they will notice that it rises one hour later each night, because it has traveled about 13 degrees (an hour's difference) farther east in its path around the earth.

Try to find out at what time the moon rises at the date of your discussion. If the moon rises in the daytime or at an hour which is so late that the children cannot observe it, look up the hour in your daily newspaper or in the almanac.

Now you are ready for the summarizing of pages 22 and 23. After these pages have been read, compare the appearance, or shape, of the real moon with the appearance of the moon on one of these pages. Tell whether the moon is at first quarter, full moon, last quarter, or new moon.

Encourage your pupils to observe at the same hour for a few evenings the changing position of the moon eastward, when it is shining, so that they can see that the moon though seemingly traveling from east to west is actually traveling from west to east.

Pages 24–29. What Is the Moon Like? This question challenges the imagination of nearly every child. Unfortunately many children are the victims of the man-in-the-moon theory and other fantastic stories. The explanation given by scientists in regard to conditions on the moon is far more fascinating than imaginative stories, and children are eager to find out all they can about our neighbor in the sky. Little motivation other than the question in the text is needed. Pupils will wish to study the pictures closely. Let them imagine themselves looking down upon the moon from an imaginary rocket ship a hundred miles or so from the moon.

If the children can possibly look at the moon through a telescope, they should do so. Even a strong pair of field glasses reveals the moon's surface with surprising clarity on a clear night. Children who have had this experience involuntarily compare what they have seen with the pictures in their book.

Pages 30–31. Make a Moon Book; Look to Find Out; A Paper Shadow. Making a moon book gives an opportunity to summarize

some of the learnings which the children have gained from their study of the moon.

1. In the picture of the first quarter of the moon, the "horns" of the moon should point to the left. The light part should curve to the right. The opposite, of course, is true of the last quarter.

2. In this picture the children will probably show sharp, high mountains, a rough, jagged, rocky floor to walk upon. The earth might be shown in the sky looking much like a moon. Allow for individual interpretations.

3. Some things that could not happen on even an imaginary trip to the moon are ice-skating, roller-skating, bicycle-riding, swimming, flying kites, and the like. It might be fun, however, to play ball on this imaginary trip. Encourage the children to tell why these things could not happen.

Looking for shadows outdoors on a moonlight night or in the home at night will provide material for further class discussion. You may wish to talk about the proper use of lights when one is reading or writing.

Cutting out a paper shadow helps to crystallize learnings about the changing position of the sun throughout the day. Of course the early morning shadow will be much longer than the noon shadow. When the sun is low in the sky, the rays are long and slanting and hence make a long shadow. The steep, overhead rays at noontime make a short shadow.

You can illustrate this further by making shadows with an electric light in a darkened room. Stand a book or other tall object on a table. Hold the light near the table. Note the long shadow. Hold the light directly above the object. Note the short shadow.

SOME THINGS THE TEACHER SHOULD KNOW ABOUT THE SUN AND MOON

In order to make some extension of the teacher's experience readily available, further information is presented at this point. Most teachers will wish to increase their knowledge by making use of the bibliography at the close of the chapter.

The sun is a great gaseous body about 93 million miles from the earth. It is many, many times larger than the earth. If the sun could be thought of as a hollow ball, a million bodies as large as the earth could be pressed into it and still all the space within the great ball would not be used.

If we could imagine the earth at the sun's center, there would be room for the moon to revolve about the earth as it does now. It has been suggested that if some "celestial Hercules" could press all the planets into one great ball, this ball would be a very small sphere compared with the size of the sun.

The sun's heat is inconceivably great. Its temperature is much higher at the center than at the surface. Some scientists believe its temperature to be 10,000° F at the surface. Great flares of hot gases shoot out from the sun for hundreds of thousands of miles.

Scientists believe that the sun's heat will continue to be as great as it is now for at least millions of years to come.

The sun rotates, but not as the earth does. Since the earth is a solid, all parts of the earth revolve at the same time. The sun, as noted by the progress of new spots, does not turn at the same rate at all points.

The sun is a star. All stars are suns. The sun and all other stars generate their own light and heat.

The sun is a medium star in all ways. It is a medium-sized star. It is a yellow star of medium heat and light as compared with other stars.

The sun gives our earth more light and heat than other stars give because it is so much closer to us. Although the sun is so far from the earth that the imagination is taxed in attempting to grasp the great distance, still it is much closer to the earth than any other star. The nearest star is four light-years away. A light-year in terms of space is the distance which light, traveling 186,000 miles per second, would cover in a year—a distance which staggers the imagination. It is not difficult to realize, then, that the sun gives us more light and more heat than any other star gives because it is so much nearer to the earth.

The moon is quite different from the sun. It is solid, as the

earth is solid. It is, however, much smaller than the earth. The diameter of the earth (8000 miles) is about four times that of the moon. If you could imagine the earth as a hollow sphere, you could also imagine many moon balls placed inside the earth.

The moon is a solid and has no light of its own. But the sun's light shines on the moon. This light is reflected to the earth. The moon also receives light from the sun which is reflected from the earth. The earth's light reflected on the moon is greater than the moon's light reflected on the earth, because the earth is a larger body than the moon.

Although the moon is about 240,000 miles out from the earth in space, it is the earth's nearest neighbor. Imagine traveling ten times around the earth at the equator. This distance would be roughly equal to the moon's distance from the earth.

The moon revolves around the earth. It also rotates on its axis. Each motion takes the same length of time—about $29\frac{1}{2}$ days. A day on the moon is about fourteen earth days in length, and a night on the moon is as long as a day. As a consequence, the day side of the moon is exceedingly hot, and the night side is exceedingly cold.

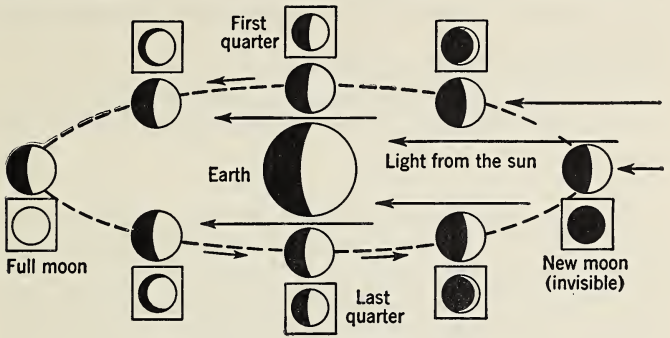
Because the two motions of the moon, one on its axis and the other about the earth, take the same length of time, the same side of the moon always faces the earth.

The changing shape of the lighted portions of the moon is explained in this way: Only one half of the moon is illuminated by the sun at one time. The illuminated side is not always turned toward the earth. Much of the time the side toward the earth is only partially illuminated. The diagram on page 25 shows how the motions of the moon cause change in the lighted portion.

Do not attempt to use this diagram with third-grade children. This concept is much too difficult at this level. These children can understand, however, that the sun's light goes out to the moon as it goes out to the earth.

The moon has little or no atmosphere, because of the smallness of its mass. Surface gravity is insufficient to prevent molecules of atmosphere from escaping into empty space.

The moon's surface is well described in the following quotation:



"The moon's surface is sublime desolation. The lunar plains are more barren than deserts. The lunar mountains are more rugged than terrestrial peaks above the timber line. Lava beds of extinct volcanoes are more inviting than lunar craters. Nothing happens on the moon. Where there is not air there can be no clouds, no rain, no sound. Within a lunar cave there would be eternal silence and inaction. A spider web across a dim recess in such a cave would remain perfect and unchanged for a million years.

"There can be no color in the moon's sky; only blackness and stars during the bitter night two weeks in length and only glaring sun during an equally long day. Such a desolate region as the moon's surface could benefit us only as an observing station for an astronomical expedition or as a possible source for precious ores, could we cross the 239,000 miles of forbidding vacuum and survive the dangers of open spaces."[1]

EVALUATION OF LEARNINGS

What have we learned? The following concepts should become quite firmly established in the minds of most of the children in your group by the time the study of this unit has run its course:

[1]F. L. Whipple, *Earth, Moon and Planets*, p. 137. Blakiston, 1941. Quoted by permission of the publisher.

The sun rises in the east and sets in the west. It is high in the sky at noon.

Light and heat come from the sun.

We have day when the sun shines upon our part of the earth. We have night when the sun does not shine upon our part of the earth.

Day and night are as different as can be.

The moon's appearance, or shape, is always changing. Each night for about two weeks, the lighted part grows a little larger. It keeps growing larger until the moon is big and round. This is the full moon. Then each night for about two weeks the moon becomes a little smaller until none of its light can be seen. Now the moon reappears and again grows larger each night. These changes take place over and over, all the time.

The moon is a real place as the earth is real. It is far out in the sky. It has no air to breathe, and no plants or animals live on the moon.

There should be no attempt to have the pupils memorize a list of learnings. On the other hand, they should understand and remember essential facts. You may therefore wish to have the pupils summarize what has been learned. To do this, suggest that they make a chart on which they state the things they have learned. You can place this chart on the bulletin board where it can be referred to as occasion arises.

The exercises at the end of the chapter give opportunity for a teacher to evaluate the learnings which children have achieved. If adequate learning has taken place, the children will be able to carry out these exercises easily and capably.

If real learning and growth have taken place, the pupils will continue to show interest in the subject and will seek to carry out further activities. The exercises in the book are planned to give pupils some such opportunities.

Other activities have been mentioned at various points throughout this chapter in the Manual. Further opportunity for pupil learning may be discovered in some of the references listed in the bibliography below.

MATERIALS AND EQUIPMENT

Crayons or poster paint; scissors; Manila drawing paper, 9″ × 12″; lined composition paper; wrapping paper or newspapers pasted together to make a strip about 8 or 10 feet long.

BIBLIOGRAPHY[1]

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, pp. 50–55 and 73–78. Ginn, 1940.

Craig, Gerald S. *Science in Childhood Education*, Bureau of Publications, Teachers College, Columbia University, 1944.

Garrison, Charlotte. *Science Experiences for Little Children.* Scribner, 1939.

Hoban, Charles F., and Zisman, S. B. *Visualizing the Curriculum.* Cordon, 1937.

Jean, Frank C., Harrah, E. C., and Herman, F. L. *Man and His Physical Universe.* Ginn, 1943.

Whipple, Fred L. *Earth, Moon and Planets.* Blakiston, 1941.

For the Children

Horn, Ernest, and others. "Telling Directions by the Sun" in *People and Places.* Ginn, 1940.

Johnson, Gaylord. *Stars for Children.* Macmillan, 1934.

Meyer, Jerome S. *Picture Book of Astronomy.* Lothrop, 1945.

Reed, William Maxwell. *The Sky Is Blue.* Harcourt, 1940.

[1]For addresses of publishers, see page 118.

The affinity which exists between children and animals is well recognized. One sometimes has occasion to wonder if Junior's devotion to his faithful terrier is not stronger, more sincere, and more understanding than his love for some of his blood relatives.

Children find many ways to express this great interest in animals. They have many kinds of pets. They talk about them. They like to bring their pets to school. However brief its sojourn in the classroom or schoolyard, the care of a pet brings about valuable learnings and problems.

An excursion or hike with your pupils through the woods and fields will produce a wealth of interests and questions in regard to the growing-up processes of many kinds of animals. Perhaps you live in a large city from which a walk through the countryside would not be a feasible activity. However, most city parks provide some opportunity for discerning individuals to learn much about living things.

We want children to do as Bob and Bill did in the first part of the chapter, "to walk and look, and look and walk." We want them to know how to observe living things in their environment.

In her effort to give intelligent guidance to children's learning through these experiences, the teacher will be aware of children's attitudes toward animals in the environment. Sometimes, because of lack of knowledge, wrong attitudes develop. Harmless snakes are regarded with disgust or fear. Children often are careless in the treatment of animals. They sometimes capture in considerable numbers useful insects, such as the praying mantis. They may have a fund of misinformation and superstition. Some may say that a grasshopper is a bug or that a caterpillar is a worm. Others may have heard that a dragonfly will sew up your mouth, or that if you put horse hairs in water and leave them there for a while they will turn into snakes.

In guiding children's experiences with animals, the teacher will endeavor to extend and enrich their interpretation of their environment. She will attempt to establish desirable attitudes. She will try to lead the children away from superstition. She will not

limit her thinking to acquiring information for information's sake, but will seek to extend learning into meanings which are basic patterns of life.

PURPOSES

The following purposes will help to promote intelligent guidance for such learning:

Life processes of all animals are similar in some respects. Animals must have food. Most animals have enemies, and in order to survive they must be able to protect themselves against enemies.

Animals are adapted in various ways to seasonal change and to conditions of weather.

Animals produce young. The parental care of the offspring varies greatly in amount and in kind.

Most kinds of animals develop gradually, and so their appearance changes gradually from the fertilization of the egg to the maturity of the animal. The development of some animals is marked by definite stages. This is called *metamorphosis*.

It is the purpose of this chapter to show that these life processes take place, and that they vary greatly among different kinds of animals.

GUIDING PUPILS' STUDY

The life histories of five different animals are found in this chapter. Box turtles, monarch butterflies, sunfish, song sparrows, and cougars represent five different animal groups. Although only centered headings are used in this chapter, it should not be difficult to perceive where the description of one animal ends and the next begins.

It is not essential for these histories to be read in the order in which they are written. Read first the story which comes closest to your pupils' interests and needs. Perhaps your group has taken a walk. No turtles were seen, but you stopped to watch a school of fish. If the fish were even the most commonplace variety of minnows, the children probably will prefer to read the story of the sunfish before they read about the turtles.

Much of the study of this chapter will consist of silent reading of the text with subsequent discussion of questions, such as those listed on this page. The narrative style of these stories permits most children to read a life history straight through. They can read freely and for enjoyment. Most of the pupils will not require the closely directed guidance demanded in the study of the preceding chapter. The main purpose of pages 31–42 of this Manual is to give the teacher additional information about each of the animals described in the children's text.

The information given in the stories in the textbook should not constitute the pupils' entire experience with these animals. It should fulfill and supplement learnings which have been gained through observation and whatever other experience is possible and desirable. On ensuing pages you will notice that a somewhat different type of activity or activities is suggested for the study of each of these animals.

Your study of box turtles will be greatly enriched by the observation of turtles which are brought into the classroom for a brief visit as well as those which remain to be cared for as permanent classroom residents.

In the study of monarch butterflies, observation is most important, and usually it is quite possible. The following questions may be used also as a basis of study. Write them on the blackboard for the children to use for a guide as they read.

How many parts are there to the life of a butterfly?

What happens to monarch butterflies in winter?

What are some other things which help monarch butterflies to go on living?

In the study of fish, several kinds of activities are suggested. Experiments, research (finding out about game laws), observation, excursions, and discussion are all used to increase information and thereby clarify thinking.

With the study of song sparrows, feeding birds during various seasons of the year and observation while taking bird walks are utilized as means of learning.

In studying about cougars, the children read for the thrill which one gains from a good adventure story. From their reading the pupils should also acquire well-established concepts of life processes, of ways of getting a living, and of adaptation to environment.

It is recommended that the pupils engage in a thorough study of one kind of animal before beginning the life story of another kind of animal.

Of course there will be some pupils in your class who read more rapidly than others. There will also be some pupils with a much broader foundation of science than others. As a means of giving wider scope to the study of these pupils, let them go as far as they can with questions such as the following:

Does the young animal eat the same kind of food that the grown-up animal eats?

Does the young animal look very much like the grown-up animal? In what way does it look different?

Can the grown-up animal take better care of itself than the young animal can? What helps to keep the young animal safe from its enemies?

These questions may be used with equal effectiveness with each of the animals studied. In the case of the story of cougars, the children might tell some of the ways in which cougars are like their own house cats.

Such questions as these should form the framework of study and discussion for all pupils in the class. The more rapid learners, however, may respond to them by such additional activities as writing, drawing, or some other form of expression. They might also list other animals for which similar studies could be made.

Pages 33–41. Box Turtles. If a living box turtle can be obtained, you will find that much will be gained from its stay for a few days as a guest of the school. Box turtles often make their way to yards and gardens in rural and suburban areas. Some child is likely to find one somewhere and bring it to school.

A large wire cage is a good place for the turtle, because it gives opportunity for the turtle to be seen by many pupils at a time. A large wooden box will do, however. Arrange in the bottom of the box a covering which resembles as much as possible the place where the turtle was found. Put in a thin layer of garden soil, and spread grass, leaves, and small sticks over it. A shallow pan of water may help to make the turtle comfortable.

You can find out what to feed a box turtle on pages 38 and 41 of the textbook. It will also eat a bit of apple, chopped meat, or small pieces of fish. Do not be disappointed if the turtle does not eat while you are watching it. If it does not eat while it is in your classroom, it will find the sort of food it prefers when it is released.

Turtles often go without food for quite a long time. Often when baby box turtles are hatched, food is not available. It is said that they sometimes crawl back into the ground where they remain throughout the winter without eating at all.

Watch the turtle as it walks back and forth. Observe how it draws its legs, head, and tail into its shell when you pick it up or when a stick or other object comes too near. Of course you will discourage handling the turtle. However, taking it out of its cage occasionally to study its structure and movement may result not only in increased knowledge of these factors but in right attitudes toward care of animals.

The shell of box turtles gives great protection, and the turtles seem quite fearless. As they amble slowly along a road at night many of them are killed by automobiles because, of course, the shell does not give complete protection.

Note the plates which compose the turtle's shell. Around these plates are concentric "lines of growth due to the alternation of a period of growth during the summer with a period of rest when the turtle hibernates during the cold season of the year."[1] Count these and you can tell about how old the turtle is.

Other kinds of turtles may be brought into the classroom for study. Mud turtles, painted turtles—brown with exquisite red

[1]Robert W. and Jane Hegner, *Parade of the Animal Kingdom*, p. 347. Macmillan, 1935.

and yellow markings around the edges—spotted turtles, and others wander close to human habitation, as the box turtle does. Their habits and adaptations are similar in many ways to those of the box turtle. As you study these other kinds, compare their structure with that of the box turtle. No other has the body so completely enclosed within the shell as the box turtle.

The turtle whose shell forms most protection has fewer other ways for protecting itself. Snapping turtles have less shell than other turtles, but a fairly small snapping turtle can pinch with noticeable effect. A large snapping turtle gives a severely painful bite to one who disturbs him. If a snapping turtle should become the object of your observation, all pupils should refrain from handling it. Mud turtles are sometimes erroneously called snapping turtles. Real mud turtles are usually harmless.

The children probably will ask, "Does a turtle have teeth?" A turtle has a bony plate around each jaw giving the effect of "teeth all merged into one." With these bony plates the food is crushed before it is swallowed. You may be surprised to see how quickly the turtle snaps up its food and swallows it. In the out-of-doors much of the animal's food is insect food, and the turtle must act quickly or go without.

A turtle's eggs are smaller than a hen's eggs. They are round instead of oval. Their covering is a tough skin, not a breakable shell.

Turtles are reptiles. They are cold-blooded animals.

Small turtles from a pet shop make fine permanent classroom pets. There are a number of ways to provide natural living conditions for these small turtles. You can use an open wooden box with a pan of water inside. You can use an aquarium or a terrarium. If you use a box, cover the bottom with clean sand. Arrange the pan of water so that the turtles can climb in and out easily. If you use an aquarium, place in it a large rock so that it extends well above the water line. The turtles must have a place where they can dry off. Turtles like to bask in the sun. The terrarium as a place for small animals to live in is quite fully described on page 66 of this Manual.

Feed your turtles about once a week. These small turtles take

food best when it is placed in water. If you are keeping turtles in a terrarium, take them out to feed them. These small turtles from the pet shop eat meal worms, earthworms, lettuce leaves, chopped meat, insects, or commercial turtle food.

Pages 42–49. The Monarch Butterfly. The cocoons of moths and the chrysalises of butterflies often can be discovered very readily as one walks through fields or gardens or along roadways. They are fastened to twigs of bushes or trees, on fence posts, or on weeds—in an endless number of places. Children often bring them into the classroom. If you are a city-bound teacher, science supply houses will provide chrysalises and cocoons for you to watch in your classroom. By all means give your pupils the opportunity to see a butterfly or moth emerge from its chrysalis or its cocoon.

The biggest thrill of all comes when a caterpillar that has spun a cocoon or made a chrysalis in your classroom emerges in the spring as a moth or butterfly. When children bring caterpillars into the classroom, experiment with available leaves, grasses, or cabbage until you find a leaf that the caterpillars will eat. Encourage the children to observe carefully the plants near the place where the caterpillar was found and to bring some leaves from these plants.

Place the caterpillars in a box large enough for plenty of twigs with foliage. Keep these moistened. Cover the box with a wire mesh so that the caterpillars will not crawl away.

When a butterfly emerges from a chrysalis, have "honey flowers" available—thistles, clover, honeysuckle, nasturtiums. If you cannot obtain flowers which give a natural supply of food to the butterfly, make a thick sirup of sugar and water.

Many moths have poorly developed mouth parts and may not eat at all. The life of the adult butterfly or moth may be very short. Watch for eggs which may be laid before the female dies.

In the discussion of this story you will of course emphasize the fact that there are four stages in the life of the butterfly. If you have read about box turtles first, you will compare the develop-

ment of the two animals, showing that one has a slow gradual development, whereas the other has definite changes.

Moths and butterflies are often confused in the minds of adults as well as of children. Many people call each and all "butterflies." Many moths spin a cocoon for their pupal stage. Most butterflies change as the monarch butterfly changes; that is, the skin of the caterpillar turns into a hard covering.

A moth's resting position is usually with wings outspread. A butterfly holds its wings upright when at rest. The antennae of most moths are featherlike in appearance, whereas those of a butterfly are like tiny horns with knobs at the ends.

The adaptation which butterflies and moths make to winter varies. It is not likely that many of them can endure the cold weather while in the adult stage. The adults of many species die when winter comes. Monarch, mourning-cloak, and other species migrate to warmer areas. The adaptation made by most moths and butterflies is the pupal stage. The pupal stage of many kinds of moths and butterflies is spent above the ground. Their firm covering protects them from freezing weather. Some moths and butterflies spend the winter underground in the pupal stage.

Some children may express wonder that the young of an animal as delicate as a butterfly or moth do not need great care. Of course many of the young lose their lives, but their safety (continuance of the species) lies in the vast number of the young which are born.

Pages 50–56. Sunfish. Sunfish are common to the water of most parts of the United States. They are found in brooks and small rivers and often are referred to as the small boy's fish. They are small in size and easy to catch. Perhaps your pupils will know them as pumpkin seeds or crappies.

Much can be learned from the care of fish in the classroom. You will need an aquarium. A gallon of water for an inch of fish provides adequate living space. Water plants are essential to a balanced aquarium. Further specifications for building an aquarium will be found on pages 254–256 of *Science for the Elementary-School Teacher*, by Craig.

If you have no aquarium, certain fish may be kept in a large glass bowl. Minnows from a near-by stream or pond live well in a small aquarium. If your local game laws allow it, you may wish to study a few of these in your classroom. The tropical fish from a pet shop are surprisingly hardy, often responding to an artificial environment even better than minnows which may have been brought in from running streams. Commercial fish food probably is your easiest and most fool-proof food for these fish. Do not overfeed them.

Many learnings result from the responsibility and care of these animals. One of these is the ever-present demand for food. Along with this is the realization that the quantity of food must be controlled. The children will soon learn that uneaten food clouds the water and makes it impure. The fish cannot take in air effectively from water in which food is decaying.

The children will learn that fish take in air that is in the water. Perhaps the fact that air is in water is difficult for them to comprehend. In that case try this experiment. Let a tumbler of water stand until air bubbles collect around the inside of the glass. This shows that there is air in water.

Your aquarium needs a large open top so that air can get to the water. A bowl with a small top does not always admit an adequate amount of air; hence the water needs to be changed frequently. It is a good thing to use a sheet of glass for a cover, in order to keep dust and certain other impurities away from the water. In order to provide an adequate amount of air, leave a space of at least one-half inch between the surface of the water and the glass.

Watch the fish as they take in air. The opening of the mouth sends water out through the gill openings. As it flows over them, the gills take air from the water.

Watching the fish in the aquarium can be looked upon as a very profitable use of leisure time. Encourage the children to observe how the structure of a fish helps it to live in its water home. Apart from its breathing mechanism, a fish is admirably constructed to live in water. It would have a hard time to get about on land. Ask the pupils to find out some of the things about

a fish which help it to live and move and grow easily in water but which would make life difficult for it on land. Even the covering of a fish adapts it to life in the water. See how the scales overlap like shingles on a roof, streamlining the fish and enabling it to move swiftly. Let the children see the scales of a fish from the market. It is evident that the toughness of the scales is a real protection to the fish when attacked by its water enemies.

Ask the pupils to find out about the game laws for certain fish in your community. Have them find out why the government makes laws of this sort.

If there is a fish hatchery in your community, you will want to visit it. Stocking the streams with young fish is most important. Try to find out how often fish are put into the streams, which kind need to be replenished most frequently and why.

Many or all these matters will come up during your discussion before and after you have read the story of the sunfish. Your best returns from reading will be increased discussion. Encourage your pupils to discuss what they read. Then give them the opportunity to reread in order to answer questions which have come up during your discussion. If they do not find answers to their questions in this book, they will wish to look for the answers in other reading material.

Pages 57–66. Song Sparrows. Throughout the United States, song sparrows can be recognized. There are many species of this busy, cheerful, brown bird. They are native to mountains, valleys, deserts, and farm lands. They thrive in city and in rural areas. All children have the opportunity to see them, to hear them, and to know them.

Not all song sparrows have the markings of the Eastern song sparrow on whose "breast wedge-shaped markings of black and rufous-brown tend to form a larger blotch at the center." In deserts and mountains the bird is a lighter brown with smoother coloring.

If you and your pupils take a walk to see and hear birds, you may be disappointed. At the time of day when you are walking, birds are often under cover. On the other hand, they appear

when you least expect them to, but they move about so quickly that you have time only to ask, "What is that bird?"

Probably the best way to observe birds is to wait at a feeding station in the winter or near a bird bath in spring or summer. School children take pleasure and pride in building each of these, and much information can be gained from using them. Even a window sill in a city school can serve the purpose. Children can make many interesting discoveries while watching at these vantage posts.

One of the things that children talk about in this connection is the fact that birds eat, eat, eat. They never seem to stop. Birds use up a great deal of energy in their flight. Much food is needed to supply this energy. A large part of their food is small food. Because they take food into their bodies in such small amounts, they must be continually at the job of eating. As children observe this, they can appreciate the untiring efforts of the mother song sparrow as she cares for her numerous broods of young during the nesting season. They can appreciate the pounds and pounds of weed seeds which the song sparrows eat in cool weather, and what a great help that is to farmers.

The children may wish to make a record book of the foods which certain birds prefer. Some of the foods which will attract winter birds are listed here:

Commercial birdseed	Pieces of apple	Cracked corn
Sunflower seed	Commercial chick feed	Suet
Rolled oats	Oats or wheat	Small pieces of bread
Meal worms		Cooked meat

If your pupils are reading this story in the autumn or winter, they may be allowed to examine a song sparrow's nest. By studying the text on page 60 they will know where to look for such a nest. By reading this text and studying the pictures on pages 60 and 61 they probably will be able to recognize a song sparrow's nest if they find one. It will do no harm to take such a nest into the classroom in autumn, as song sparrows do not return to the nest a second year.

If you are reading this story in spring, your pupils will be filled

with delight if they locate a song sparrow's nest containing eggs or young. Most children have a high sense of honor and will not harm the eggs or the nest, but they must use the utmost care not to frighten the birds away.

Some children may feel that there is little resemblance between the fine-looking mother bird and the squirming, unfeathered baby birds with their long necks, big heads, and closed eyes. But it can be pointed out that the baby birds have head, body, wings, legs, and feet as the mother has. The growth of the bird until it resembles the parent precisely is a gradual change. Its development is not a series of changes, as is the case of the monarch butterfly.

The children may be rather easily discouraged when learning to watch birds. The birds jump about so quickly and fly away so abruptly that it is difficult many times to get a really good look at them. On the other hand, the difficulty itself will reveal to children very clearly and forcefully that characteristic which is the best defense of many birds against their enemies. Countless numbers of times a cat has been all ready to pounce upon a bird only to have it dart away from under his very paws. Birds have many defenses against enemies. These are described in the next chapter.

Children's sense of fair play makes them willing to take measures against a cat which catches birds. If one's pet pussy is a bird-catcher, no amount of training will change its ways. Its value as a mouse-catcher usually is defeated by its destructiveness as a catcher of birds.

The short migration period of song sparrows takes place for only the most severe part of winter. This bird is well adapted to coping with cold weather. It is a hardy bird. It finds good ways to keep on living against the odds of weather.

Pages 67–76. Cougars. Most of the children who have seen cougars have observed them from the protected areas of a zoo. Although cougars are so infrequently seen by children on their native heath, they challenge the imagination of most boys and girls. The life of a cougar has an appeal comparable to that of pirates, buccaneers, and other lawless but fascinating rascals.

In order to be concrete, you might start your reading with a motivating question such as this: "Are cougars the kind of animals I like or are they animals to be feared and disliked?"

After the children have read the whole story with this question in mind, they should be ready for the discussion suggested on page 42 on this Manual. The additional information which is given on the next few pages will help the teacher to be an interesting participant in this discussion.

Cougars are quite universally distributed throughout North and South America. They are found not only in heavily forested areas but in desert regions as well. They have many names. In some regions they are referred to as pumas; in others they are panthers or painters. To many people they are mountain lions. To most of us, they are cougars.

There is some difference of opinion in regard to the character of cougars. Some authorities declare they are mean and cowardly. Others regard them as fine, brave animals with astute cunning. It is generally conceded that cougars do not attack people unless first attacked by them. On the other hand, few woodsmen, if they are unarmed, care to meet a cougar face to face.

A cougar is a cat. In reading about the cougars in this story, the children will recognize many qualities which are displayed by their cats at home. A cougar is a stealthy hunter, cautious and quiet in its movements. It looks like a cat. It has pointed ears and sharp claws. It makes skillful use of its paws. Study the pictures with the children to see that there are many resemblances to a house cat.

Cougars are like house cats in another way. They do not like dogs. When people hunt cougars, they often use dogs. Sometimes cougars climb up into a tree to get away from the barking dogs. Sometimes they run out across the open fields, where they become easy quarry.

Cougars carry on a well-developed family life. Except when the kittens are very young, the mother and father live together. Until the kittens are about ready to be weaned, the father stays away from them. If he stayed with them, he would eat them. However, the father provides food for the mother at this time,

leaving it near the home where she can reach it easily. When the kittens are ready for meat, the father joins the family again.

Young cougars are spotted, as they are shown in the picture. It is said that this indicates that remote ancestors were spotted as leopards are spotted. By the time the kittens are six months old, their coats have the smooth yellow-tan color of the parents. At seven weeks the kittens are about the size of house cats.

The young cougars play as other kittens do. The parents often play with them. Some people say, "A cougar is always a kitten." At any rate, the grown cougars are very playful. They roll about, run, hide, and jump out at each other. They even like to play when they are alone, chasing butterflies if nothing better comes their way.

The cougar is well protected against his enemies. Children can easily point out these defenses. Strength, stealth, sharp claws and teeth, and nocturnal habits all make cougars an enemy to be feared by man and beast.

When food is scarce, cougars often travel from twelve to twenty miles in search of meat. Cougars often cover a kill with brush or leaves. They even return for a second or third meal. When food is abundant, however, they are wasteful eaters. They often kill several animals at a time, eating only the most appetizing parts and leaving the rest.

Children who live in the cattle country look upon the cougar as a genuine menace. Cattle-owners have battled against them with guns, traps, poisoned meat, and the like. Man's successful struggle against their predatory ways has pushed these animals back into the mountains, rocky places, or deep forests, and so today they are seldom seen.

The cougar is a magnificent beast in many ways—beautiful in body, tireless, and shrewd in his attacks. However, as the textbook says (p. 72), "The cougar is not friendly to any other animals. In all the woods and fields, no other animals are friendly to him." Like a true cat, he is more or less inscrutable and a law unto himself—the cat who walks alone.

After reading the life story of cougars in the textbook, the children will have considerable information to discuss. The

teacher should guide discussion with well-directed questions, such as the following:

Why is the cougar feared by man and other animals?

If you could do so safely, should you like to watch a cougar catching its prey? Why? Why not?

The mother cougar is a good mother. Is the father cougar a good father? How can you prove your answer?

During this discussion the children should have their books ready to use. They may read orally parts which prove points made or which answer controversial questions. The children may want to read orally the parts of the story which make them like cougars or dislike them.

Pages 76–77. Something to Think About; Something to Try. "Something to Think About" consists of recapitulation and generalizations in regard to information which has been presented in the chapter. After the pupils have read this exercise, give them the opportunity to do just what the title implies. Let them *think about* what they have read.

Perhaps you will wish to discuss parts of this exercise. The children may want to describe instances in which a certain kind of animal has been of help or has not been of help to people. Perhaps they will wish to talk about animals which do or do not give much care to their young.

Discussion of these generalizations need not be considered essential, however. Reflective thinking in itself is a worth-while part of learning. This line is often quoted, "The thoughts of youth are long, long thoughts." How much opportunity does the school give for this characteristic of youth to develop into sufficient intellectual growth? Here is one opportunity which can be utilized toward that end.

"Something to Try" is an exercise designed to put a tangible purpose into the activity suggested on page 28 of this Manual, namely "to walk and look, and look and walk."

This exercise is to help children to observe and learn and, at the same time, to appreciate the meaning of conservation. In

this activity they can possess a pet without taking it away from its natural habitat.

EVALUATION OF LEARNINGS

What learnings does this unit hold for children?

There are ever so many specific learnings, too many to be listed here. Such details as the food on which sunfish thrive or the kind of nest which a song sparrow builds are here in abundance, but it is not the purpose of study merely to memorize these details. They are the "bricks in a larger structure"; they should be used to build up larger meanings or concepts by which children can interpret their environment. Some of these meanings are stated below. Of course it will be understood that this list of meanings is not to be memorized either. The meanings should be the outgrowth of the children's experiences.

In the lives of some animals, such as turtles and fish, little change takes place in the parts of the body or in the shape of the body.

In the lives of other animals, such as butterflies, great change takes place.

The appearance of some animals, such as song sparrows and cougars, changes very much; but there is no great change in the different parts of the body.

The many kinds of animals that are in the world are different in many ways. They are different in size and shape. They are different in the way they grow, in their habits, and in their ways of living.

Some animals give great care to their young; other animals give their young little or no care. Some animals live together as a family; others pay little attention to one another.

Birds, insects, reptiles, fish—all are animals.

No matter how different from its parent the young animal seems to be, if it lives, it will someday be like the parent.

How can we know that children have acquired these learnings? Sometimes we do *not* know right away. Sometimes the learning

is expressed long after the experience has taken place. However, we can discover a little of what children have learned by seeing what they do with what they have studied.

What contributions are made to discussion?

What response do the pupils make to the activities suggested in the book? to those suggested in the Manual?

How eager are your pupils to read the life story of other animals?

The following are some suggestions for further activity on the part of the pupils:

Read the life stories of other animals.

Observe other animals of the kinds described in the book—other kinds of turtles, other kinds of birds, and so on. If the children cannot find these in the out-of-doors, try to find pictures of them in various phases of their lives.

Find other animals in the larval stage—other caterpillars, potato beetles, and cabbage worms. Find as many kinds of pupae as possible.

Find out about other animals, such as toads, frogs, newts, that go through metamorphoses.

Plan to have the children give reports to the rest of the class on what they have found out about these animals.

MATERIALS AND EQUIPMENT

Pictures of animals described in text; aquarium stocked with goldfish or other small fish (An aquarium, together with properly balanced stock of plants and animals, can be obtained from Turtox Co., General Biological Supply House Inc., 761–763 E. 69 Place, Chicago, Illinois. Send for catalogue. A good pet shop will also supply a well-balanced stock of plants and animals for an aquarium); sheet of glass to cover top of aquarium; cocoons, chrysalises (These may be obtained from Turtox Co. See above); insect cages; terrarium (This is described on page 66 of this Manual).

BIBLIOGRAPHY

For the Teacher

CRAIG, GERALD S. *Science for the Elementary-School Teacher*, pp. 294–303; Chap. XVII. Ginn, 1940.

CRAIG, GERALD S. *Science in Childhood Education.* Bureau of Publications, Teachers College, Columbia University, 1944.

CHAPMAN, FRANK. *Handbook of Birds.* Appleton, 1932.

GARRISON, CHARLOTTE. *Science Experiences for Little Children.* Scribner, 1939.

HEGNER, ROBERT W. and JANE. *Parade of the Animal Kingdom.* Macmillan, 1935.

MOORE, CLIFFORD B. *Book of Wild Pets.* Putnam, 1937.

POPE, CLIFFORD H. *Turtles of United States and Canada.* Knopf, 1939.

For the Children

ALLEN, GERTRUDE E. *Everyday Birds.* Houghton, 1943.

BRONSON, WILFRID S. *Turtles.* Harcourt, 1945.

BUCKINGHAM, B. R., ed. "Mrs. Turtle's Nest," pages 195–199 in *The Great Idea and Other Stories.* Ginn, 1934.

FENTON, CARROLL L. *Wee-Jack and His Neighbors.* Day, 1944.

GATES, ARTHUR I. "Turtles," pages 132–141 in *Friends and Workers.* Macmillan, 1945.

HUNTINGTON, HARRIET E. *Let's Go Outdoors.* Doubleday, 1939.

MATSCHAT, CECILE. *American Butterflies and Moths.* Random, 1942.

PARKER, BERTHA. *Fishes.* Harper, 1941.

SMITH, NILA B. "Toby of Crow Island," pages 226–231 in *In New Places.* Silver, 1945.

WEED, CLARENCE. *Insect Ways.* Appleton, 1930.

WITTY, PAUL, ed. "Old Snapper," pages 19–29 in *Fun and Frolic.* Heath, 1942.

FILMS[1]

Snapping Turtle | Butterflies | Sunfish | Birds of Prey

[1]See page 119.

III. MANY WAYS TO LIVE AND GROW

This chapter is an outgrowth of the preceding chapter, "How Some Animals Live and Grow." Your pupils have been reading about the ways of living of five specific kinds of animals—box turtles, monarch butterflies, sunfish, song sparrows, and cougars. They have learned that each of the five kinds of animals has certain ways of getting food, of escaping enemies, and of adjusting to weather and seasonal change. Now your pupils are ready to consider such facts as these:

There are many, many kinds of animals in the world.
There are many, many ways for animals to get food.
There are many, many ways for them to escape their enemies.
In many, many ways animals are protected against stormy weather and change of seasons.

The title of this chapter, "Many Ways to Live and Grow," is practically a plunge into the following problem: "We have been studying about how *some* animals live and grow. Now we are ready to find out more about many, many ways by which animals keep on living on the earth."

PURPOSES

The purpose of this chapter, then, is to develop such science learnings as these:

Certain adaptations in the structure of the animal and in its adjustment to the environment are necessary if the animal is to live out its life.

The animal must be able to get food.
It must be able to escape its enemies.
It must have ways of protecting itself against stormy weather and dry weather and against seasonal change.

Each kind of animal has its own ways of achieving these ends.
Not all animals have the same ways of living. What is a good way for one animal to live may not be good for another animal.

The ways of living of each kind of animal are good for the survival of that kind of animal.

GUIDING PUPILS' STUDY

The value of firsthand experience cannot be overestimated. Learning gained through one's own observation has a scope and intensity that no other means can supply. In achieving real comprehension of the ways of living just presented, you and your children will gain much by being familiar with the out-of-doors.

Fortunate indeed, from this standpoint at least, are those teachers whose schools are in the country or at the edge of town. However, you do not always need to take long walks in the wide meadows or the deep woods to discover much about the ways of living things.

Of course the season of the year as well as your location will determine to a very great extent what you can hope to see during your excursion in the out-of-doors. However, a few general suggestions are in order.

Try to find animals that seem to be preparing for winter. You may see many birds circling about in the sky. Perhaps they are swallows flocking together for their winter's migration. Look for cocoons and chrysalises. Look at the coats of squirrels or other animals. Dig up a piece of earth. Perhaps you will find beetles, wasps, or other insects in process of early hibernation.

See if you can find animals feeding. Take some grain, nuts, or fruit along to feed the squirrels, chipmunks, or other animals which may cross your path.

Watch to see how the animals eat this food. Watch to find out what they do with what they do not eat. Perhaps some of it will be stored away for winter use.

If you live in the country, many of these opportunities will be open to you. The city also offers many possibilities for observing living things. You may even find that the pupils will be interested in following a woolly-bear caterpillar until it comes to a final stopping place. Watch English sparrows. See how hardy they are and how well they are fitted to survive in a city environment.

Most city children are familiar with flocks of pigeons. Try to find out what happens to city pigeons during a heavy winter storm.

Make the most of opportunities to observe water life. In the country it is often possible to follow a brook to observe fish, water insects, or even birds nesting along a bank. In suburban areas someone not too far away from the school may have a garden pool to which the children can have access for study of fish, tadpoles, snails, and water insects.

Take some mud and water from the bottom of a pond or brook. Place this in a jar or aquarium to see if some kind of animal life comes out later on.

These are but a few of the things one can look for and do on a walk out of doors. You and your pupils should be the best judges of what to see while you are walking. Perhaps the most important feature of such a trip is not *what* you see but *how* the activities of your trip are carried on.

Do not try to see too much at a time. Calling attention to all the things going on about your pupils may tend to confuse them rather than to increase their learning. Is it always necessary for each pupil to look at everything in which the teacher is interested? Give pupils time to make their own discoveries. Each child will not make all discoveries, nor will all pupils be interested in the same discoveries. Do not hurry an excursion in the out-of-doors. Many times the most fascinating and worth-while discoveries are made toward the end of an excursion. Try to allow enough time so that the value of an unexpected discovery need not be lost.

An excursion taken with specific questions in mind is often very fruitful. Your pupils may be interested as they start out on a walk to consider the problems set up in the book on page 79: "If you were a wild animal of the fields or woods, would you be able to stay alive?" "Where would you look for food?" "How would you get away from cold and stormy weather?" "How would you keep safe from your enemies?" Perhaps some of the pupils will try to find out how a specific animal carries out one or more of its life needs.

The children will have seen many interesting things in their excursions out of doors. They will have discovered what they

believe to be many ways in which many, many animals live and grow. They will be prepared to read the material in the book with at least two purposes. In carrying out the first purpose the pupils will verify the observations they have made. In carrying out the second purpose they will find out more about the ways which enable animals to go on living.

Pages 80–84. Animals Must Have Food. The book says, "There are many kinds of animals in the world. They eat many kinds of food."

Give the pupils opportunity to read to find out what the many, many kinds of food are. Take plenty of time to discuss what has been read. It would be interesting to consider the question "Is man's food more like that of one animal than it is like that of another animal?" Bring out the fact that man's food has most of the characteristics brought out in the book. Some of his food, such as grain, is very tiny. Some, such as beef, is very large. Man eats both plant and animal food. Some of his food comes from water, but man is a land animal and most of his food is "land food."

Try to watch animals feeding. Watch a horse, a cow, or a fish. Perhaps a honeybee or butterfly on a flower would be easier to find. Or watch a fly eating a few grains of sugar which you have placed near a window. Note how the structure of each animal enables it to eat its own kind of food.

On page 84 of the textbook the term *ladybird* may be unfamiliar to some pupils. Point out to them that the beetle eating tiny insects in the picture is properly called a *ladybird,* though commonly referred to as a *ladybug.*

Pages 85–87. Many Ways to Catch Food. Several ways of catching food are presented here—stealth and watchfulness, fierceness and strength to kill, and power of numbers. Study the pictures. Let the children imagine the chance which an animal would have against the animal or animals shown in the picture.

Some child may be distressed at the knowledge that one animal is so universally used as food by another. They do not like the fierce lion which eats the gentle zebra. They may even feel sorry

for some insects which are eaten by frogs or toads. At this point they can be helped to realize that mosquitoes, mice, houseflies, and many other animals would make life unendurable for us if they were not used for food by other animals. Animals need not be considered cruel when they eat each other. It is the only way some animals have for getting food.

Pages 88–93. In Stormy Weather. Give an opportunity for the children to answer the question on page 88: "Suppose again that you were a wild animal of the woods or fields. Could you keep warm in cold times and stormy weather?"

Have the children first list on the board the ways by which they keep warm in winter. Then, as they read, let them compare these ways with the ways of other animals.

Give the children a chance to recall the patchy appearance of the coats of animals which they have seen out of doors in the fall or in the early spring. Examine the feathers of a duck or a winter bird to see how the thickness and overlapping of the feathers help to keep out the cold winter wind.

You may wish to let the children discuss the following problems: "How does the safety of your home compare with that of the homes of other animals?" "How does the amount of time which you spend in your house to keep warm compare with the time spent by other animals?"

Some animals have one defense against cold winter which most people do not have. Let children read to find out what this defense is [migration].

Try to find out about other animals that migrate in winter. Recall monarch butterflies. Bring pictures of seals, Rocky Mountain sheep, and bison. These animals migrate, also. Find pictures of many kinds of birds which migrate. Display these on the bulletin board.

Pages 94–100. Animals and Their Enemies. In the pictures on pages 94–95 you see a mother deer with her fawn lying on the floor of the forest. The sun, shining through the leaves, dapples the floor and makes it resemble the color of the deer and fawn. The woodchuck, sitting up near the stump of a tree, is the color

of dry grasses. The toad looks like a clod of earth. The tree frog is the color of the branch on which it rests. Study these pictures carefully and talk about the animals portrayed. Note that it is not easy to see these animals because of their coloration. Such coloration that hides an animal from its enemies is called protective coloration.

In taking a walk try to find other animals which are camouflaged by color—grasshoppers, toads, cabbage worms, butterflies among bright flowers in a garden, the praying mantis on a green grass stem, and so on.

We are not often able to examine very closely in real life the means of defense with which animals are endowed. Help the children to recognize each animal in the pictures on pages 96–99 and its special means of defense. Thus the honeybee in the upper left corner of page 96 has for its weapon a sting (shown in the circle). The poisonous snake in the lower left corner of the same page has fangs (the long curved teeth in the upper jaw). The wolf's teeth, the cow's horns, the rooster's bill, the horse's teeth and hoofs are all weapons of defense.

The porcupine in the upper left corner of page 98 has quills, which it can make to stand up like needles to protect itself. The snail and the turtle at the top of the same page have their shells to retire into for protection. The lobster and crab are equipped with pincers and a hard covering to ward off enemies. The fish has its scales. The clam and oyster, at the bottom, are protected by hard shells.

The green caterpillar on page 99 is protectively colored and, like all the other animals on the same page, has a repelling taste. The ladybird warns away enemies by its color, indicating a disgusting savor. The toad is foul-tasting and hard to distinguish from its surroundings. The monarch butterfly warns birds of its bad taste by its bright colors. The weasel at the foot of page 99 is not relished by meat-eating animals.

It is the purpose of the picture on page 100 to show that some animals protect themselves by running away from danger. Let the children discuss the speed with which a snake or a lizard, for instance, can slither out of sight, how quickly a bird darts out of

one's reach, or the rapidity with which a squirrel or chipmunk runs across the ground.

Your frequent discussions of the ways by which animals are able to go on living should emphasize the fact that these animals do not think and plan as people do. Nevertheless, each kind of animal has ways that are effective in its protection. The pupils should also come to realize that while man is always finding new and better means of survival and comfort, other animals continue to use the same ways of living year after year.

Page 101. A Question Box. This exercise gives another opportunity for reflective thinking. The children will give varied responses to these questions. No attempt is made to dictate the replies to be given, but the essential meaning is about as follows:

1. Although greater strength is needed for the lion to capture a zebra for food, the chickadee also uses much energy and strength in acquiring its food. The chickadee uses as much strength and energy for its size as the lion uses for its size. Whereas the lion can take a rest after the capture has been made and the food eaten, the chickadee must keep at work throughout the day and every day to gather enough food for its needs.

2. Although a beaver needs a warm house in winter, a blue jay is equally safe and comfortable in its shelter in the evergreen trees. Not all animals need the same kind of shelter in winter.

3. A rabbit which runs away from its enemies is not cowardly. It is using its best defense. Although some kinds of rabbits use their strong hind legs to kick over certain enemies before running away, they are not built for fighting as a wolf is. It is easier and more effective for a wolf to fight than it would be for a rabbit to try to do so. Each kind of animal keeps safe from its enemies in a way that is best for that kind of animal.

4. Each kind of animal has a way of taking care of itself. There is no *best* way to do this. Each animal uses a way that is best for that kind of animal.

Further discussion of page 101 will be found on pages 55 and 56 of this Manual.

SOME THINGS A TEACHER SHOULD KNOW ABOUT ADAPTATION

You have been reading and observing the ways by which certain animals are adapted to food-getting, to weather and seasonal change, and to protection against enemies. These adaptations are not a conscious process on the part of the animal.

An animal eats what it does for two reasons. First, the food is plentiful in the environment. Second, the structure of the animal enables it to eat this food.

Many birds eat only insects. They live only in an environment where insects are plentiful. These birds probably would not survive the winters of the cold north because during that season the insects which constitute their diet are not available in the environment. Grasshoppers might endure the cold of winter, but probably would die of starvation because there is so little plant food in the winter environment.

Not all animals are adapted structurally to eat certain foods which may be plentiful in the environment. An animal can starve in the midst of plenty because its structure does not permit it to eat the kind of food that is all about it. For instance, chickadees find good feeding in the seeds of weeds that usually can be found in abundance, but flycatchers would be likely to starve during a cold northern winter because they would be unable to find insects to snatch out of the air for food. They could not survive on the weed seeds, which are plentiful, since they are not equipped structurally to eat weed seeds.

On the other hand, many animals are so constituted that they can eat many kinds of food and survive in a variety of environments. Song sparrows eat seeds when insects are not available. Cockroaches and mice can eat practically anything and everything and so survive in what would be meager environment for most animals.

Animals are adapted to survive the cold of winter in many ways. Frogs, toads, snakes, and other amphibians and reptiles seek refuge underground in winter. The cold makes them so sluggish that they cannot move. They spend the winter in an inactive state. Certain mammals too go into a state of low vi-

tality during the cold months. A woodchuck's breathing and heartbeat are almost imperceptible during its period of hibernation. Only warmth will restore it to an active condition.

Bears, chipmunks, skunks, and certain other mammals have only partial hibernation, coming out of their holes when the weather is mild.

Grasshoppers, many beetles, ants, and many kinds of wasps spend the winter underground. Many other insects pass the winter in the pupal stage.

Migration is a means by which many animals besides birds meet certain needs of life. Mourning-cloak butterflies and certain mammals have been mentioned in previous pages. In the spring salmon migrate to fresh water to spawn, while eels migrate to salt water for the same purpose.

The text has described adaptations by which many animals are protected against enemies. One adaptation which has not been mentioned is that of complete silence and lack of movement on the part of the animals. Grouse are so protected. Chapter 3 of *One Day on Beetle Rock* gives a delightful account of how a grouse saved its life in this way. Rabbits often "freeze" into obscurity. Protective coloration increases the effectiveness of this defense.

"Changing conditions of temperature, food supply, and sunlight are met by adaptations which enable the animal to survive. Where there are less pronounced changes in the seasons, the adaptations are not so marked. The greater the difference between the conditions of one part of the year and others, the greater the range of adaptations which may be noted."[1]

EVALUATION OF LEARNINGS

To evaluate the learnings which children have achieved from this chapter, the teacher should think first, "What learnings are there to be gained?" These learnings are stated as follows:

The life of animals holds many difficulties and dangers.

[1]Gerald S. Craig, *Science for the Elementary-School Teacher*, pp. 354–355. Ginn, 1940.

Food-getting is probably the most difficult problem an animal has, especially in times of unfavorable weather conditions.

Some animals eat plant food. Some animals eat other animals. Some animals eat both plants and animals.
Some animals survive because they can eat many, many kinds of food. Other animals always eat about the same kind of food.
Some animals eat food so tiny that we cannot see it without a microscope. Other animals eat food that is very large, larger than themselves.
There are many ways for animals to capture food.

There are many ways for animals to survive cold and stormy weather.

Some animals acquire warmer coats. They seek refuge in sheltered places during storms.
Some animals spend the winter underground.
Some animals build winter homes.
Some animals spend the winter in the south, where it is warm and where there is food.

Animals are protected from their enemies in many ways.

Some animals are protected by their color.
Some are fighters.
Some have hard, tough coverings.
Some have a bad taste.
Some animals protect themselves by fleeing from their enemies.

What children *do* with what they have studied usually is a better check on their learning than are most quiz procedures. How well can your pupils carry out activities suggested in their book? in the Manual?

Have a lively discussion based on "A Question Box," p. 101. If you are in favor of homework, you might have the children read this page at home and prepare to discuss the problems next day. Give consideration to answers which may not be in accord with your way of thinking or with that of most of the class. The

conclusion to be reached is given in the third of the three paragraphs under "Purposes," pp. 46–47 of the Manual.

Construction activities are good measures of children's learning. Make a frieze or wall panel showing animals in winter. Use a large piece of brown wrapping paper. Draw your outlines with white chalk. Color your picture with poster paint or large colored crayons.

An interesting panel may be made, showing a cross section of an area in the winter. Include a pond. Have ice at the top of the water, fish near the mud at the bottom of the pond, and snakes, turtles, and frogs underground. Show also a woodchuck's burrow and a rabbit's hole at the foot of a tree. Children will think of many items to include in the picture, which might be entitled "How Some Animals Spend the Winter." You may wish to show life aboveground as well as underground. In that case you will make a very large picture which can represent the work of all members of the class.

Perhaps you will prefer to have two or three smaller panels. The children may work in groups to show "How Some Animals Catch Their Food" and "How Some Animals Escape Their Enemies."

You need not wait until you have completed your study to begin this construction. Plan it in the early part of your study. Work on it as you proceed with your reading and observation.

MATERIALS AND EQUIPMENT

Same as those on page 44 of this Manual.

BIBLIOGRAPHY

For the Teacher

CRAIG, GERALD S. *Science for the Elementary-School Teacher*, pp. 277–290; Chap. XVII. Ginn, 1940.

CRAIG, GERALD S. *Science in Childhood Education.* Bureau of Publications, Teachers College, Columbia University, 1944.

CARRIGHAN, SALLY. *One Day on Beetle Rock.* Knopf, 1944.

HEGNER, ROBERT W. and JANE. *Parade of the Animal Kingdom.* Macmillan, 1935.

MOORE, CLIFFORD B. *Book of Wild Pets.* Putnam, 1937.

POPE, CLIFFORD H. *Turtles of United States and Canada.* Knopf, 1939.

For the Children

ALLEN, GERTRUDE E. *Everyday Birds.* Houghton, 1943.
BRONSON, W. S. *Pollywiggle's Progress.* Macmillan, 1932.
BUCKINGHAM, B. R., ed. "What Jane Found," "How Some Animals Hide," "Our Friend the Toad," pages 75–81, 126–131, and 158–166 in *Munching Peter.* Ginn, 1934.
BUCKINGHAM, B. R., ed. "Joe Bear" and "The Wise Old Frog," pages 186–194 and 268–272 in *The Great Idea and Other Stories.* Ginn, 1934.
FLACK, MARJORIE. *Tim Tadpole and the Great Bullfrog.* Doubleday, 1934.
GALL, A. C., and CREW, F. H. *Flat Tail.* Oxford, 1935.
HORN, ERNEST, and others. "The Black Bear Cubs," pages 7–21 in *Making New Friends.* Ginn, 1940.
HORN, ERNEST, and others. "Baby Boo" and "Our Friend the Toad," pages 9–29 and 88–97 in *People and Places.* Ginn, 1940.
HORN, ERNEST, and others. "Engato the Lion Cub," "Elephants," and "The Little Brown Bat," pages 9–29, 86–119, and 170–181 in *More Adventures.* Ginn, 1940.
HUEY, EDWARD G. *A Child's Story of the Animal World.* Reynal, 1935.
HUNTINGTON, HARRIET. *Let's Go Outdoors.* Doubleday, 1942.
KANE, HENRY B. *Tale of the Bullfrog.* Knopf, 1941.
KANE, HENRY B. *The Tale of the Crow.* Knopf, 1943.
KANE, HENRY B. *The Tale of the White-Faced Hornet.* Knopf, 1944.
KANE, HENRY B. *Tale of the Whitefoot Mouse.* Knopf, 1940.
KING, ELEANOR, and PESSELS, WELLMER. *Garden Creatures.* Harper, 1939.
MATSCHAT, CECILE. *American Butterflies and Moths.* Random, 1942.
MELLEN, IDA M. *Twenty Little Fishes.* Messner, 1942.
PATCH, EDITH M. *Holiday Pond.* Macmillan, 1929.
PARKER, BERTHA. *Fishes.* Harper, 1941.
PARKER, BERTHA. *Reptiles.* Row, Peterson, 1942.
STEARNS, DAVID M. *Chuckle, the Story of a Woodchuck.* Farrar, 1939.

FILMS

Common Animals of the Woods
Birds of Prey
Spiders
Black Bear Twins
Frog
Gray Squirrel
How Nature Protects Animals

IV. ANIMAL HOMES

This chapter is the outgrowth of the two preceding chapters. It has been shown that there are many ways by which animals survive unfavorable weather and seasonal change. One of these ways is through the protection given by the home in which the animal takes refuge.

A home is not only for the purpose of defense. It is the place where the young are reared. We think of the home as the basic unit of society. Even though a child's home may be a poor home spiritually as well as physically, it is the seat of his security. It is the place most familiar to him.

The word *home* is a word children understand. They are curious and alert in their investigations of many kinds of animal homes.

PURPOSES

The following purposes will help children to interpret their observations and gain meanings from their investigations of animal homes:

There are as many kinds of animal homes as there are kinds of animals.

Animal homes are built in many kinds of places.

Each kind of home is suitable for the animal which builds it. Animals build the kind of homes they need.

There are many purposes for homes—shelter from storms, shelter from cold winter, a place to rear young, a place to stay while structural changes are taking place (cocoon), a place where the animal can feel comfortable and where it can be safe from animal enemies.

GUIDING PUPILS' STUDY

In this study your pupils will develop a real sense of the interrelationships that exist among living things. They will discover relationships between parent animals and the young. They will realize that some animals need and receive from the parent only

a start in life, while with other animals the relationship between parent and young is close for a period of time.

The children will note interrelationships between animals and their physical environment. They will find that animals usually build their homes in places where food can be obtained easily. They build near places where materials are available for their type of home.

Your pupils will discover the great variety of kinds of homes. They will see that this great variety of homes meets the great variety of needs of a great variety of animals.

The children will discover also that there are interesting adaptations to living conditions. Some animals have a winter home and a summer home. Needs growing out of an animal's life pattern are met in many ways. Children should look for adaptations as their study proceeds.

You and your pupils will wish to go to the out-of-doors to study about animal homes. You will look for birds' nests, you will peer into holes in the ground, you may dig down into the ground to see what you can find. You may spend a while watching a squirrel running in and out of a hole in a tree, or in the spring you may have the thrill of seeing a downy woodpecker or a sapsucker hammering out a nest in a tree near your school. As the book says, "As you look about, you can see many kinds of homes."

Page 104. Homes on the Ground. Only one kind of home is described here. The children probably know about many other kinds of homes that are made on the ground. For example, many kinds of sparrows nest on the ground. The vesper sparrow makes her nest in a shallow hole at the top of the ground. She lines it with dried grasses and horsehair. This bird is sometimes called the ground bird. Its gray-brown color, with black stripes on the back, make it seem a part of the ground where its nest is built.

The meadow lark too has a fine nest on the ground. This nest has an unusual structure. It has a dome-shaped cover of grasses. This keeps the rain away from the eggs. A short runway is made through the grass. The meadow lark flies to the end of the runway and walks through it to the nest. A meadow lark's nest is

very hard to find, but if you are determined to find one, look in the tall grass near a fence.

Among other birds which nest on the ground are pheasants, killdeer, grouse, and quail.

Pages 105–108. Homes under the Ground. As you study the picture on page 105 you may not be able to identify all the animals. The wasp is a yellow jacket. The curled-up grub is a cutworm. Ants, a trap-door spider, a Japanese beetle, and an earthworm comprise the rest of the group.

Dig up a clod of earth to discover some of the animals that make their homes right under your feet.

Try to find a place where you can watch chipmunks at work. Perhaps you can see them hiding away food, as the book describes. Note how rapidly they scamper about. Refer to the preceding chapter. Their speed is a good way for them to escape their enemies. They will even scamper away from you if you get too close.

Try to find the hole where the chipmunk goes underground. Perhaps if only one or two children are left to watch, the chipmunk will reveal this secret better than if the whole third grade is standing by.

Pages 109–110. Homes in Water. As the children study the picture on page 109, they will realize, of course, that in it the side of the house has been cut away. Many schools are so situated that the pupils can walk to a swamp or pond to observe the homes of muskrats. These children will know without being told what has happened to the house in the picture.

Some of your pupils may be confused by the fact that they have seen muskrats' holes in the muddy bank of a river or creek. The house which is described in the book is the winter home of muskrats. Their summer home is the tunnel in the muddy shore of the river or lake. The young are born in these tunnels—not in the more intricately made home described in the text.

If your pupils have seen or heard about the summer home of muskrats, this would be a good opportunity to introduce the scientific method of thinking. They have discovered that the book

describes muskrats' homes in one way; they have observed the home to be of a different sort. Which is right? Further investigation proves that both are right. The children will be helped to realize that further investigation is often necessary before a conclusion can be reached. They should also understand that it is better to investigate a seeming contradiction than to allow oneself to be lost in confusion.

Only one type of home has been described here as being made in or near water. Many other animals make homes by water. Beavers build homes that are much like the muskrat homes. They are larger and cleaner than muskrat homes, however.

The nest of the red-winged blackbird is made in the high marsh grasses. The stems of these grasses are pulled together high above the waterline, and the nest is made where the grasses come together. This nest is placed advantageously near the seeds which red-winged blackbirds prefer, and it is in a spot where insects can be captured easily.

The mallard duck makes a beautiful nest by the water. It is placed on the ground among the tall grasses. It is made of grasses and lined with fluffy down from the mother's breast. A picture to be remembered is a mother mallard surrounded by her young sailing along the water looking for food as the sun is setting. Animals usually make homes near a place where food can be obtained easily.

Page 111. Homes near the Ground. Look about to see if you can find a nest in a hedge, a rosebush, or other low bush near your school.

Because these nests are near the ground, children can observe them easily. They can see how carefully the nests are attached to the twigs and branches. Read again to see why these nests though near the ground are yet a safe distance above the ground.

Pages 112–114. Homes in Trees. Go out to look at a tall tree. Look upon it as a great apartment house. Even if you cannot see homes of birds or squirrels in the tree, perhaps you have evidence that they are there. Look in the bark for pupae of insects. You

may find insects eating into the wood. Try to find out what they are and if these homes are permanent or temporary.

Pages 115–117. Homes in High Rocky Places. Children quickly recognize the protection afforded animals which live in these inaccessible places. This topic provides another opportunity to tie up the present learning with the preceding chapter. Here is an example of migration as a means of meeting winter conditions. Food is not altogether plentiful in many of these high places. Most birds which nest on barren rocks fly to some other place for food. Mountain sheep and goats, however, have a frugal diet, and it seems to be adequate for their needs.

Pages 118–120. What Are Homes Made Of? The picture on page 118 is designed to show homes made of wood. This is the winter home of the squirrel. The summer home where the young are raised is far out on a slender branch. It is a loosely made ball of sticks and leaves, giving the impression that it is about to fall apart at any moment. It seems to hold together very well, however, and is safely placed against enemy attacks.

The animals whose homes are pictured on page 119 are the spider, tent caterpillar, polistes wasp, and the caddis fly in its stone covering. The caddis worm is in a larval stage at this time. The tiny stones covering its body are held together by means of silk which the animal secretes. The moving water of the stream carries food to it, so it is not necessary for it to move about. However, it does crawl about on the bottom of the stream. It can pull its head and legs into this stone case when necessary. At the end of the body are hooks which hold the caddis worm in its case.

The pictures at the top of page 120 show the nest of the mud-dauber wasp and of a barn swallow. Below are nests of the chipping sparrow and house wren.

Pages 121–129. Carefully Built Homes; Quickly Built Homes; This Is a Good Home; No Homes. These four parts of the chapter describe what seem to be very carelessly built homes as well as those that are built with great care. The pupils have read about many kinds of homes, and you have observed many kinds of homes.

Call their attention to the question on page 121, "Is one of these homes better than another?"

It is a good thing to get children's reaction to this question before reading farther. However, the pupils should not assume that they have the final answer to the question. They have made only an assumption, a speculation. Record the answers given. Write them on the board or on paper and save them as a record for later reference. Read through page 129 before coming to a definite conclusion. Perhaps you will wish to read through to the end of the chapter before being sure of your answer.

The children should come to realize that an animal always makes its home in the same way, although it may not always use precisely the same materials. It uses the materials which the environment provides. Sometimes grasses are supplemented by bits of string, ribbon, or a small rag. A pigeon's nest was discovered on the window ledge in an office building on Wall Street in New York City. The pigeon had used ticker tape, excelsior, rubber bands, and hair.

An animal's home is always built with about the same degree of efficiency. Many homes are ingeniously and intricately made, but the first nest a bird makes is as well made as the last one. No improvement is shown as the result of learning or practice. Building of homes is instinctive with animals. Man has made improvement in the comforts, effectiveness, and beauty of his homes because he can think and plan.

Pages 130–131. What Are Homes For? You will wish to make use of the question on page 130, "What does your home do for you?" Let the children tell why they are glad that they have homes.

Then let them tell how homes are used by their pets. See what they can tell about the use which other animals make of their homes. If you take this procedure, your children will read pages 130–131 to verify the answers which they have just given.

A common misconception of many children is that birds use their nests as a refuge from storms. Place much emphasis upon the last three paragraphs on page 131 to be sure that the chil-

dren are in possession of the real facts in regard to the use which birds make of their nests.

Pages 132–133. See for Yourself; Be a Builder Yourself. The purpose of the exercise "See for Yourself," like "Something to Try" on page 77, is to motivate observation and firsthand experience. Whether your school is in the city or the country, you can find some outdoor animal homes.

Encourage the children to carry out this activity when they are strolling about by themselves. Perhaps you will wish to take a field trip the purpose of which would be to carry out the suggestions made in this exercise.

The concepts which have been developed in this chapter on "Animal Homes" can be increased and strengthened through active experience in helping to provide homes for animals. "Be a Builder Yourself" is designed to help children to appreciate and understand some of the difficulties which animals often face in providing homes for themselves and their families. Children also gain a wholesome respect for the remarkable skill displayed by many animals in the construction of their homes.

2. On page 38 of this Manual you will find a list of foods which will attract winter birds.

3. The birds use the water in a bird bath not only for bathing but for drinking purposes.

5. Many children honestly believe that they could combine materials into a fairly substantial bird's nest if they tried hard enough and if they kept at the job long enough. Respect for the nest-building skill of birds is increased considerably after these children have attempted to do this and have failed to carry out their purpose.

EVALUATION OF LEARNINGS

It is not recommended that a teacher have her pupils memorize learnings which are listed as desirable. On the other hand, good thinking often may be developed by providing an opportunity for children to review and organize in their minds what they have been studying.

Let the children summarize the learnings gained from this chapter. List these on the board or on a large chart. The chart may be placed on the bulletin board near the science center. Refer to the "Purposes" on page 58 of this Manual for a guide to this list. The children's list may be more specific than this, however.

Now that your children have studied three chapters about the life of animals, they are in a position to summarize their learnings in another way. They will want to share their learnings with others. Invite another grade to a program in your classroom or give a school assembly program. In this program the children may explain some of the objects which they have placed in their science center. They may display their frieze or wall panels. They may give reports on some of the things which they have learned about animals.

Reports might be given on such subjects as these:

Where animals build their homes
What homes are made of
What homes are for

You might have a debate on what is a good home. Let the children discuss such questions as: "Is an oriole's nest better than a nighthawk's nest?" "Does the chipmunk take better care of its young than a May fly does?" Such an activity helps to emphasize the fact that each animal makes a home that is best for that animal and that each kind of animal gives its young the kind of care it needs.

Your evaluation and summary will also include a discussion of the exercises given at the close of the chapter on pages 132–133, under the headings "See for Yourself" and "Be a Builder Yourself."

Before your children start to read the chapter, you as the teacher should have studied these exercises. You should have planned how to carry them out at times which will be appropriate to best learning. You are the best judge of the appropriate time to use each one that you have selected.

MATERIALS AND EQUIPMENT

Wood for building birdhouses; hammers, nails, saws; large pan of water for bird bath; terrarium or vivarium (An ordinary aquarium or a large shallow goldfish bowl can be made into a terrarium. Put a layer of sand and charcoal in the bottom to provide for drainage. The charcoal is a deodorant. Then add, to a depth of about three inches, rich soil from the woods, together with moss and other plant life. A little pool of water may be made by sinking a small dish into this soil. Cover the terrarium with a sheet of glass. Moisture will condense on the sides and top of the terrarium and will fall back into the soil, so that it will not be necessary to water the plants very often. One or two salamanders, one or two toads, a small turtle or two or even a small snake may be kept in a terrarium of this kind).

BIBLIOGRAPHY

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, Chap. XV. Ginn, 1940.

Craig, Gerald S. *Science in Childhood Education.* Bureau of Publications, Teachers College, Columbia University, 1944.

Carrighan, Sally. *One Day on Beetle Rock.* Knopf, 1944.

Chapman, Frank. *Handbook of Birds.* Appleton, 1937.

Hegner, Robert W. and Jane. *Parade of the Animal Kingdom.* Macmillan, 1935.

Moore, Clifford B. *Book of Wild Pets.* Putnam, 1937.

Pope, Clifford H. *Turtles of United States and Canada.* Knopf, 1939.

Cornell Rural School Leaflet. *Homes* (Vol. 31, No. 3). New York State College of Agriculture, Cornell University, 1938.

Cornell Rural School Leaflet. *Holes in the Ground* (Vol. 35, No. 5). New York State College of Agriculture, Cornell University, 1941.

For the Children

See the references given on pages 45 and 57 of this Manual.

FILMS

Birds of Prey	Adventures of Bunny Rabbit	Robin Redbreast
Sunfish	Common Animals of the Woods	Gray Squirrel

V. WHAT A MAGNET CAN DO

One never knows when some child will bring a magnet to school. When this happens, a group is sure to gather around the child with the magnet. The children watch to see what the magnet can do. They want to get their fingers on the magnet. They try to make it do something which the other children have not tried. They enjoy doing the old activities again and again.

Magnets should be a part of the equipment of all classrooms. Small magnets usually can be obtained from five-and-ten-cent stores. In normal times larger magnets can be purchased from a science supply house or from a hardware store.

PURPOSES

These purposes point out specific learnings which may result from experiments with magnets and which will help the teacher to make the most of the challenge which the power of magnetism holds for children.

A magnet attracts iron and steel.

A magnet does not attract string, paper, and other such substances.

The pull of a magnet goes through paper, glass, air, water.

GUIDING PUPILS' STUDY

As the teacher studies the text before working on it with the children, she will see that this is a "doing" unit. Children experiment to find out what a magnet can do. Little explanation is given.

You will want to work with the children. Endeavor to have enough magnets for several children to use at the same time.

After a period of free activity with the magnets, have the children read pages 135–138. Before reading page 138 give them the question "Why do some things stay on the magnet while others do not?" Some of the children will be able to answer this question. Others will not. Reading this page will give information to those who do not have it. It will summarize and substantiate

the thinking of those children who had the answer to the question before reading.

After reading page 139, let the children discuss the question "Did the magnet really hold the paper?" Some children may think: "Seeing is believing. The paper is held to the magnet. The magnet attracts the paper as well as the nail." These children need to study page 140 very carefully.

The reading of each of pages 141, 142, and 143 should be accompanied by performing the experiment or activity described on that page. Give the children the opportunity to see that magnetism really works in these ways.

Page 143. Just for Fun. This activity is really a game, as the title indicates; but it is a game with a purpose. Its purpose is to increase children's consciousness of the power of magnetism and to increase their knowledge of the effect which this power has upon various objects.

"Additional Activities" have been presented to carry out the same purposes.

ADDITIONAL ACTIVITIES

The interest of some of your pupils in the work of magnets will be greater than that of other pupils. They will hold to the subject much longer. They will want to try further experiments. Further activities in which these children may engage are suggested here:

1. Measuring the pull of a magnet through air.

Lay a ruler on your desk. Place a small nail on the figure 1 on the ruler (1 inch from end of ruler). Place your magnet at about figure 3. Slide it slowly along the ruler toward the nail. At what inch or fraction of an inch is the magnet when the nail hops over and fastens itself to the magnet? How far has the nail moved?

This is the measure of the pull which the magnet has for this particular nail. Take a smaller object, such as a fine needle. Do the experiment again. Can the fine needle be pulled a longer distance than the heavier nail?

2. Working with a miscellaneous collection.

Some children will go on testing the magnet's pull with all kinds of objects. Assemble a collection of screws, pins, hooks, and the like. Try to include the same object made of brass and also of steel. Or you may find some hooks made of plastic. Then try to find a similar hook made of steel. Of course the children will find that the magnet will pull some of these objects but not others. It will not pull the brass screws. It will not pull the brass pins. It will pull only those which are made of steel. This should help children to avoid making sweeping statements such as "A magnet will pull pins. It will pull screws and hooks." It will pull *some* hooks, *some* pins, *some* screws, but not all. Exactness is part of the scientific method.

Include in your collection a piece of tin cut from the top of a tin can. A fairly powerful magnet will pull this piece of "tin" about. The children may be surprised at this. Explain to them that the can is not made of pure tin. It is made of iron with a thin coating of tin. The magnet attracts the iron in this object, not the tin.

3. The pull of a magnet goes through many substances.

Continue the experiments begun on pages 140 and 141. The pull of a magnet will go through a piece of cloth. A fairly strong magnet will attract objects through a piece of glass or through a thin strip of wood.

Let the children find out if the magnet will attract objects through the piece of "tin." Use your strongest magnet for this. You will find that objects are not attracted to the magnet through the piece of "tin."

4. Playing with boats.

Continue experimenting with the cork-and-paper boats with the needle masts, described on page 143. Make several of these little boats.

Fasten two boats together by driving the head of a needle into one cork and pushing the point of the needle into the other. See if your magnets will pull the two boats. Fasten several boats together in this way. How many boats can be pulled by your magnet?

If you have magnets of various sizes let the children experiment to find out the maximum number of boats which each magnet will attract. This helps the children to see that the power of different magnets varies. Usually a larger magnet is stronger than a small one.

The comparative strength of two or more magnets may be tested by having a boat race. Let two or three children choose a boat to race against the others. Each child will have a magnet in his hand to pull his boat across the water in the pan. The boat pulled by the strongest magnet will, of course, win the race.

Put the boats on the water. Do not have them attached to one another in any way. Move a large magnet back and forth ahead of the boats. It is fun to see one boat start ahead while the others are left behind. The leadership will be taken by one boat after another, which makes an exciting race.

5. Making a magnet.

Take a steel nail or a needle. Rub one end of a magnet—always the same end—along the nail. Move the magnet always in the same direction. Press gently and move slowly. Between strokes lift the magnet well up above the object being magnetized. Repeat for twenty or thirty strokes. This treatment should magnetize the nail so that it will pick up a needle. The needle should pick up another needle smaller in size.

SOME THINGS A TEACHER SHOULD KNOW ABOUT MAGNETISM

The common magnet has several shapes. The bar magnet, horseshoe magnet, and U magnet are different shapes of the same kind of magnet. These are found in many laboratories and schoolrooms.

The bar magnet is a straight bar of magnetized steel. The horseshoe magnet and U magnet are essentially the same except for shape. They are really bar magnets bent into the shape of a horseshoe or the letter U. The horseshoe magnet is the kind most frequently brought into the classroom. The U magnet occasionally is owned by some child, or the teacher may have acquired one. Horseshoe and U magnets can be purchased at local stores in normal times.

The electromagnet is much more complicated and will not be considered here. Suffice it to say that electromagnets render great service in industry by unloading steel rails from cars, carrying large pieces of steel from place to place in factories, and in many other ways.

Try to pick up objects with the middle of a magnet. Now try the ends. Which part of the magnet holds objects more firmly—the middle or the ends?

The force of a magnet seems to be concentrated in the ends. The two ends of a magnet are called the poles of the magnet. Each magnet has a north pole and a south pole. Opposite poles attract. If you wish to have one magnet pick up another, the north pole of one magnet must touch the south pole of the other. Like poles repel each other.

The experiment which the children try on page 142 really demonstrates what can be termed borrowed or induced magnetism. It also emphasizes that some magnets are temporary magnets.

The soft iron in each nail or the steel in each needle is magnetized so long as it is in contact with the magnet. Soon after each nail or needle leaves the magnet, its own magnetism vanishes. It therefore is a temporary magnet.

The purpose of this particular experiment, however, is not to introduce the concept of borrowed magnetism or of temporary magnets. Its purpose is to find out how much a magnet will carry. The explanation given above is for the teacher's information. Do not attempt to develop this concept with your pupils. Most of your pupils would be confused by your doing so.

The experiments which your children have performed show that magnets have a field of attraction. "The region between the poles and about the poles of a magnet is called the magnetic field, for it is in this region that iron and steel are attracted by the magnet. It should not be thought of as a field with an exact border or fence around it. It has been assumed that a magnetic field is filled with magnetic lines of force which cause magnetic substances to be attracted by the magnet."[1]

[1]Gerald S. Craig, *Science for the Elementary-School Teacher*, p. 443. Ginn, 1940.

Many teachers as well as children ask, "What makes a magnet work? What is magnetism?" The answer to these questions is so intricate and involved that most third-grade children would be confused rather than enlightened by it. In fact, adequate explanation is too long and involved to be included in this Manual. The teacher who is particularly eager for this information should consult *Science for the Elementary-School Teacher*, by Craig.

EVALUATION OF LEARNINGS

Most teachers will not need to be advised that children's learnings for this chapter can best be evaluated by the responses which they give to the experiments performed. Some children will wish to perform more experiments than others. Some children will have their interest satisfied by a few activities with magnets.

Do not attempt to "high-pressure" the latter children into further experimentation. Hold to the minimum presented by the book. Perhaps not all your pupils will be able to carry out all of these. You can easily judge whether or not the purposes listed at the beginning of this chapter have been achieved by most children. See what they do with magnets. Listen to their conversation. Watch their reactions when other activities of physical science are presented.

MATERIALS AND EQUIPMENT

Horseshoe magnets (Small horseshoe magnets usually can be obtained from a five-and-ten-cent store. Larger magnets can be purchased from a hardware store); nails of assorted sizes; ruler; small square of cloth; small square of window glass about $3'' \times 3''$; thin strip of wood about $\frac{1}{8}$ inch in thickness; glass tumbler; corks; needles.

BIBLIOGRAPHY

Craig, Gerald S. *Science for the Elementary-School Teacher*, pp. 438–453. Ginn, 1940.

Arey, Charles K. *Science Experiences for Elementary Schools.* Bureau of Publications, Teachers College, Columbia University, 1942.

Croxton, Walter C. *Science in the Elementary School.* McGraw-Hill, 1937.

Imagine, as well as you can, what would happen if electric power should be turned off for half an hour at all of the power stations in the world. The situation would have results so dire that the idea of such a happening is beyond conception.

Most of us have experienced the brief absence of electricity when an electrical storm has interrupted the circuit at the local power house. In reliving this experience, one has a slight appreciation of the degree to which electricity governs the modern world. Electric power, with it many advantages and its inconveniences as well, is rapidly reaching even the most remote rural areas.

Children take for granted some of the important influences in their environment. Because of their immaturity, most children give little attention to the influence which electricity has upon the modern world or even to its influence upon their own lives. As soon as they have glimpsed the importance of electricity in their lives, they are likely to become enthusiasts in discovering for themselves many of the ways in which their lives are governed by it.

By carrying on very simple activities and experiments with electricity, children begin to have a concept of the workings of electricity. They begin to be aware of some of its great powers. They begin to appreciate a little of its influence upon the life of man.

PURPOSES

It is the purpose of this unit to develop learnings through which children will gain concepts of the workings of electricity and its effect upon everyday life. Among these learnings are the following:

Electricity affects our living in many ways.

Most of the electricity we use comes to us from a power house.

We can find out about some of the workings of electricity by means of dry cells, an electric bell, and wires.

Electricity travels. It travels from the power station to all places where it is used, including the home.

Electricity travels along a pathway. Electricity travels from the dry cell through a wire to the bell and back through another wire to the dry cell.

Electricity cannot be seen.

We must be very careful in handling anything which uses electricity.

GUIDING PUPILS' STUDY

The study of this chapter may be approached in one of at least two different ways. One possibility is to carry on your study in the sequence employed in the book. Probably most teachers will prefer to use this approach.

However, we are not always compelled to begin at the beginning of things. You may wish to begin your study by working with electricity after the manner described on pages 158–162. After you have spent some little time working with electricity, turn to the first page of the chapter. The ways in which electricity is used in everyday life can then be considered from the standpoint of the way in which electricity works. You may find that the children read of the wonders and uses of electricity with greater understanding from having worked specifically with it before this reading (pages 145–157) takes place. The last section of the chapter, pages 164–166, should be used as a conclusion.

Although distinct values are to be found in the second method, the suggested procedure which follows will hold to the sequence of topics in the text.

As a starting point, you might have the children follow the suggestion given on page 145. Let the pupils think of all the ways that electricity helps them. Write this list on the blackboard. Count the number of ways which you have recorded. It may be that a list of all the ways which children can tell about will be too long to record. Do not be troubled about this. The situation will serve to emphasize the fact that we are helped by electricity in countless ways. The picture on pages 144–145 suggests some of these ways.

Pages 146–153. Electricity Gives Light; Electricity Makes Things Move; Electricity Spreads the News. It would be a good idea to have these pages read aloud by the children. When you come to questions in the text, stop to discuss them. When references are made to pictures, stop to discuss the pictures or answer the question which the book asks about them.

Through this oral reading and discussion, emphasis is given to the momentous effect which electricity has upon our everyday living. To more and more people in all parts of the world, electricity is becoming an indispensable utility.

Pages 154–158. Electricity Comes to Your Town; No One Sees Electricity. Electricity travels with the speed of light. Its speed is one of the remarkable things about electricity. From their infancy on, children are fascinated by the instant response of electricity to the pressing of a button or the pulling of a cord or chain. Where does the electricity come from when the light appears as quick as thought? This question challenges the thinking of the growing child.

Study the picture of the inside of the power house on page 155. Emphasis is upon size of the generators with their indication of power and energy. A trip to the average power house is of value to older children but not to children of this age. However, the study of this picture will give them some idea of the magnitude and power that are inherent in an electric plant.

Children in small towns are likely to have seen the outside of a power house. If such a plant is near your school, some of the pupils may wish to study the outside of the building and observe the high-tension wires going out from it. Encourage this and make use of the report which they will bring back. If some of your pupils plan to do this in their out-of-school hours, caution them about places that are placarded as dangerous. They must not go so near as to cause anyone to be concerned about their safety. Their best caution is to do their observing with their father or some other interested adult.

Excellent photographs of the inside and outside of electric plants are found in the picture collection put out by Creative

Education Society, Mankato, Minnesota, Visualized Curriculum Series.

Encourage the children to ask their parents to show them where the electric wires come into their own homes. In many houses the conduct wiring shows quite plainly along beams in the attic and cellar. Encourage the children to look for this and trace the wiring as far as they can through the house.

Perhaps the janitor of the school building will show the children where the electric wires enter the school building. In localities where street wiring is aboveground, it will be little or no trouble for the children to trace the wires from the street to the school building.

Pages 158–160. Electricity at Work. Many teachers find that a period of free experimentation with working materials is an excellent way to promote constructive thinking. Collect such materials as the book describes for working with electricity—dry cells, an electric bell, bell wire. You may include a few small sockets and flashlight bulbs to good advantage.

Leave these on a table without comment at first. For a while observe the children as they experiment with these materials. Be ready to give help where necessary, and also be ready to forestall trouble. For instance, see to it that the pupils do not attach a wire so that it connects both posts on the same cell. The cell will become hot and eventually burn itself out if a wire is left in this position for any length of time.

Encourage girls to participate in this experimentation. If you make a playhouse or a marionette theater, do not assume that the girls will make the curtains while the boys do the wiring of the lights. If working with electricity fits a girl's practical needs, she will be interested in it. Most girls are as interested in working with electricity as boys are.

After the period of free experimentation, your pupils will be ready to read what the text tells them about wiring a bell. Let the children experiment with each step as the book directs.

Pages 161–162. Electricity Travels along a Pathway. The concept that electricity travels will be a new one to most eight-year-old or

nine-year-old children. Electricity seems instantaneous in its manifestation. Because of this, children do not think of electricity as *traveling* from place to place. Be ready for questions or comments to this effect.

Before reading about the pathway for electricity, talk with the children about other pathways on which the traveler always returns to the starting place. Some trolley lines in a city go around a big loop. Many busses go a certain way to their destination and return by another route to the place from which they started. They complete a circuit. Discuss such pathways with your pupils. Perhaps someone will place a diagram of such a pathway on the blackboard. Electricity must make a complete trip around its pathway, or circuit, if it is to make the bell ring.

Pages 163–164. Use Electricity with Care. Even before the children approach these pages they will have sensed the need of using care in their activities with electricity. Avoid comments which will cause children to become afraid to use electrical appliances or to experiment with dry cells. On the other hand, intelligent caution is a desirable attitude.

The children may wish to add some suggestions of their own to the safety measures presented on page 164.

Pages 165–166. Electricity and Good Times. Discuss local recreation centers—a swimming pool, skating rink, baseball park, driving range on golf links, or whatever recreational facilities the community provides. Find out about the lighting of these places. Are they illuminated so that people can use them at night? If this is the case, they use many powerful light bulbs and much electricity.

Give the children a chance to tell about other ways in which electricity helps them to have a good time. Encourage bringing electric trains to school. An amazing amount of learning about the workings of electricity is gained from playing with an electric train.

Page 167. Something to Make. Children usually find much pleasure in putting their learnings into book form. There is good

purpose in such an activity, for it enables them through graphic expression to check, summarize, and often to extend their learnings.

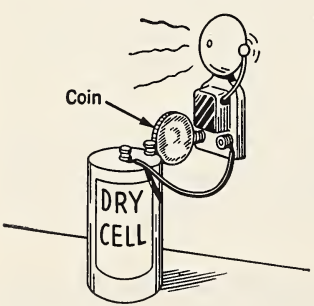
In making this book it will be noted that children not only create their own pictures and diagrams but also search out pictures from various sources in order to carry out specific purposes. This is a form of research. Interest in and the ability to carry on research are desirable outgrowths of work in science.

Perhaps not every pupil will wish to make a book of his or her own. Under many circumstances it may be feasible to construct one book only. You may set this up as a class project with each member of the class making at least one contribution to it. Such a book may be used to show other groups of children. At the end of the school year, it may be left in the classroom to be used as reference material by the group which will occupy the room another year.

FURTHER ACTIVITIES

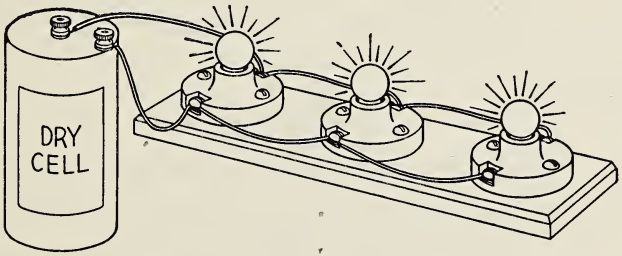
In their study of electricity, as in other studies, your pupils will display individual differences. Some children will work much faster than others. Interest in the subject will last much longer with some children than with others. Some children think more maturely than others. All these children should have the opportunity to carry out activities beyond those suggested by the book.

1. Electricity does not always need a wire for its pathway. You can connect dry cells with the electric bell in a way different from that shown in the book. Use a wire to connect the middle post on the cell with one post on the bell. Place the dry cell close to the other post on the bell. Take a silver quarter or a copper penny. Place the coin so that one part of its rim touches the post on the dry cell, and the opposite side of the rim touches the post on the bell. The bell will ring as long as the coin stays in place.



Use other objects. Try a small square of sheet copper. Try other coins. Try a piece of string. Try a plastic button; then try a metal one. Copper, brass, silver, or steel should make a pathway over which electricity can travel.

2. Perhaps your pupils would like to wire lights in a playhouse or in a theater for a marionette show. They may wish to install lights on the shelves of their science center. You will need to give them some help in this activity, but for the most part they can figure out how to fasten the sockets where they are needed and how to connect the wires to the sockets. A diagram such as the one shown below will give them much of the help they will need for this activity.



EVALUATION OF LEARNINGS

Again the evaluation of your pupils' learning will be based upon what they have been doing with their learning. Observe the reactions of the children to the activities described in the book. Try to keep a record of the participation made by each child in some activity. If you are in doubt about some children, ask those children to try to make the bell ring or to stop the bell from ringing.

Encourage the children to draw a diagram of the way electricity travels or of the way electricity comes from the power house to their homes.

Most towns have maps showing where electric mains are laid in the town. Try to get a copy of one of these maps. Examine it with the children to find out exactly how the electricity reaches their homes.

The book about electricity suggested on page 167 of the textbook will be a very concrete evaluation of children's learning.

Of course you realize that you will not need to do *all* these things in your effort to evaluate what children have learned about electricity. Choose the activity or activities which best suit your needs. Perhaps you have ways of your own which are as valuable as those suggested in this Manual.

MATERIALS AND EQUIPMENT

Dry cells; electric bell; bell wire; small flashlight bulbs; sockets to fit flashlight bulbs (These materials can be obtained from a five-and-ten-cent store or from an electric supply store); small square of sheet copper about $2'' \times 2''$; coin (penny or quarter); plastic button; metal button.

BIBLIOGRAPHY

For the Teacher

CRAIG, GERALD S. *Science for the Elementary-School Teacher*, pp. 453–477. Ginn, 1940.

AREY, CHARLES K. *Science Experiences for Elementary Schools.* Bureau of Publications, Teachers College, Columbia University, 1942.

For the Children

BEATY, JOHN Y. *Story Pictures of Our Neighbors.* Beckley-Cardy, 1938.

JUDSON, CLARA I. *People Who Came to Our House.* Random, 1940.

KEELOR, KATHERINE. *Working with Electricity.* Macmillan, 1937.

LACEY, IDA B. *Light Then and Now.* Macmillan, 1930.

The children who are now in our schools are growing up in an air age. To them travel by air is no more remarkable or unusual than is travel on land or water. They cannot conceive of being bound to the surface of the earth as man has been throughout the ages. As time goes on, they probably will think not in terms of the swiftness of air travel but in terms of the slowness of travel by land or water.

Air is very real to an eight-year-old who has traveled in an airplane. It is real to many children who have only watched planes from the ground or who have sailed their toy gliders through the air.

Concepts of the reality and nature of air should be a growing part of the consciousness of all children. The average child knows that air is indispensable to his own life. Does he know that it is indispensable to all life on the earth? Air is a physical force. Most children know that weather has an influence upon air travel. Are they aware that air has an influence upon weather?

Although our children are an air-minded group, they also are likely to take many of its manifestations for granted. Guidance is needed to help them to make interpretations of this part of their environment, to help them to grow in knowledge of the nature, composition, and manifestations of air.

PURPOSES

There are many purposes to be considered in this chapter. These are stated below in order to help the teacher to recognize specific learnings through which children gain concepts of the reality, nature, and uses of air.

Air is a real substance as much as land and water are real substances.

To study the weather, people must know many things about air.

Changes in air make changes in weather.

All living things need air.

Air is a place where travel has been carried on throughout the ages. Birds and other animals traveled in the air long ages before man was able to do so.

Air is the natural place for many animals to travel. Many animals can travel in the air even more effectively for their own purposes than man can.

Air is even more necessary for some animals as a place in which to travel than it is for man.

Some things sail in the air.

There is water in air.

Water evaporates from moist things that are in the air.

Air gives back moisture.

Warm air holds more water than cold air will hold.

We cannot see moisture in the air unless it is condensed into the form of clouds, fog, rain, or snow.

The thermometer measures how hot or how cold the air is.

It is better to use a thermometer than to guess about the temperature.

GUIDING PUPILS' STUDY

Pages 168–173. People Travel by Air. It is not necessary for a preliminary discussion on the subject of air to take place before the children open their books to read. Interest in learning about air will be stimulated as the children read about Bob's trip.

You and your pupils will want to look at the picture before reading, and probably you will wish to talk about it. You might let children wonder a bit about the safety of traveling in the kind of weather shown in the picture. Hazard guesses about the possibility that the Baker family may or may not be able to take their airplane trip.

You may prefer to open up your study by asking questions: "Do you remember a dark, cloudy morning which turned into a bright, sunny afternoon? How did you feel as the clouds began to leave the sky and the sun began to shine brightly?"

The quick rise from the dim darkness of the fog to radiant sunshine above the clouds is a thrilling experience. As the children recall the cheerful feeling which they experienced when the

day changed from cloudiness to sunshine, they will be prepared to share Bob's wonder and delight at finding sunshine so quickly.

Without further comment, ask the children to read to find out why the weather man said (on page 169) that it was all right to go ahead. Most children will want to read straight through to the end of the story on page 173.

After reading these pages the children may want to talk about the "floor of clouds" above which the plane was flying. Look again at the pictures on pages 170 and 171. You might ask, "When Bob was on the ground looking up would he call what he saw a 'floor of clouds'?" The answer, of course, is, "No, he would call it a ceiling of clouds."

Bring out the fact that we cannot always tell what the weather is above the clouds. Sometimes the clouds do not form "a floor," as described in the story. Sometimes the clouds continue high, high up in the air, so that the plane cannot climb above them. Help the children to find out, however, that if the plane could climb high enough, it would find sunshine. The sun is always shining, whether we can see it or not.

Most children who have traveled by airplane have been thrilled with a feeling of the immensity of space. As the plane goes up, up, up, the ground seems to be far, far away.

This feeling of the wideness of air and space above the surface of the earth is shared to a certain degree by the children who only read about the flight of planes or who study pictures of planes high up in the air or who watch the flight of planes from the ground.

The concept of space grows when children send their thoughts far beyond the limits of air travel. In the first chapter they studied about the moon. They imagined themselves on the moon. Passenger planes keep within a radius of four or five miles above the surface of the earth. The moon, our nearest neighbor of the sky, is about 240,000 miles away. How very, very far away other heavenly bodies must be!

Pages 174–176. Some Great Air Travelers. One purpose you will have in reading these pages is to show that man is a very "new"

flier in the history of the world. Another purpose is to show not only that birds are adapted to an air environment, but that most of them could not survive unless they could live in this environment.

Let the children read pages 174–176 without having to think much about questions. When they have finished reading, you might set up problems by saying, "You may want to think more about some of the things you have been reading in these pages. What are some of the things you have just read that you had not thought about before?"

Try to find out more about stormy petrels. After leaving the nest, these birds, as well as gannets, fly about for as long as two years without coming back to land. They sometimes come to rest on ships at sea, but they do not make a stay on land until they are ready to make a nest and rear young.

One of man's great problems in flying is maintaining an adequate fuel supply. His hours in the air are limited by this. With man, flying will always be a conscious process; with birds it is not.

Most children realize that we are living in an advanced age of scientific discovery and invention. In considering this, many of them take the attitude that today's people are more clever than those who lived in the past. Something of a spirit of condescension colors their regard for the days of the past with the comparatively slow transportation and communication and the generally different ways of living. There is also a tendency to feel satisfied with the present and to believe that things will continue on about as they are now.

This is not a scientific attitude, of course. Certain meanings need to develop within these children. They need to realize that some things which seem to be facts today may not be considered truths later on. They need to expect new inventions and discoveries. They need to realize that new discoveries make it necessary for us to change our thinking about many things.[1] It is true that the discoveries and inventions so universally used in the present mechanical age have brought about changes in ways of

[1]Gerald S. Craig, *Science in Childhood Education*, pp. 22–23. Bureau of Publications, Teachers College, Columbia University, 1944.

living and thinking that are different from the "old days." On the other hand, our present advancement may look quaint and old-fashioned to a school child fifty or even twenty-five years from now.

Pages 177–179. Things Sail in Air. Making things glide through air is a happy exercise of childhood. What group of children has not sent throngs of paper airplanes gliding through the air! These planes are made from a sheet of paper folded in such a way that they float for some distance after they are propelled from the child's hand.

To many teachers the pupils' persistence in floating these paper gliders through the air seems only a waste of time and paper. Some of the activities, however, in which children engage so persistently should be viewed as forms of experimentation. With a little guidance on the teacher's part, this paper-glider interest can become an exceedingly worth-while experience. The paper glider illustrates the buoyancy of air very clearly. Children also like to blow bits of fuzzy things through the air—dandelion, milkweed, or cattail seeds. Experimentation with buoyancy of air is a universal challenge to the interests of children.

Try to observe the many gliders mentioned in the book. Other gliders are winged seeds from the maple tree and falling leaves in autumn. Monarch butterflies do a great deal of gliding on their long migration flights. Sea gulls and turkey buzzards are gliding a large part of the time they are in the air.

All children are familiar with papers blowing in the wind. Many a child has experienced surprise and fascination when, as the wind whisked off his hat, he watched it sail away through the air.

Some children may bring in pictures of flying fish, or you may wish to do this yourself. Of course a flying fish does not really fly. It is a glider. It leaps out of the water and, using its pectoral fins as wings, glides for some distance through the air.

Air has weight. It has force. It presses on everything. Gliding and flying are subject to weather conditions. Many birds do their flying only when weather permits. During storms they seek refuge in secluded places.

Pages 180–186. Now You See Water in the Air, Now You Don't; Heat Makes Water Go into the Air; Water Comes Out of the Air. These pages develop concepts of evaporation and condensation. Let the children look about them to find water that they can see in air. If it is a cold enough day, blow your breath into the air. Look at the "steam" from a factory whistle or a steam engine. This is not really steam, of course. Steam is invisible. As the steam is released from the whistle or engine, it condenses. The cloud which you see is condensed steam, which is visible. This cloud soon evaporates, and you see it no longer.

Sometimes many clouds are in the sky. As the children watch these clouds disappear from the sky, they ask, "Where do the clouds go when we can no longer see them?"

These clouds may not have been blown to far distant regions. They too may have evaporated into the air around them. Water truly is in the air. If it were not for the water in the air, we should be completely scorched by the heat of the sun.

Try to imagine what the world would be like if no water at all should evaporate for a while. A painted picture would stay wet. Our faces would be wet, and we could not keep them dry. Clothes, dishcloths, wet shoes, bath towels, all would stay wet and disagreeable. It would be much worse than a rainy summer day when things take a long time to dry. Playing with this idea will help children to realize what a very great amount of water goes into the air from the everyday things around them.

The concept of condensation is subtle and difficult for children to understand in its entirety. Do not press the issue of "Do you understand?" This may be one of the instances in which experience is the best teacher. See that your pupils have many experiences with evaporating water and with condensation. We know that warm air holds more water than cold air. We want children to realize that, too. Utilize the many experiences that are familiar to them.

Changes occur continuously in the universe.[1] The children experience the concept of change as they experiment with evapora-

[1]Gerald S. Craig, *Science in Childhood Education*, p. 44. Bureau of Publications, Teachers College, Columbia University, 1944.

tion and condensation of water. They experience change in manifestations of air, such as changes of weather and changes of temperature. They witness changes in the relationship of air to living things. They watch for weather and temperature changes and for the effect of these on their own activities and the activities of others.

Page 187. Can You Tell? Bob's suit will dry fast if it is hung up so that air can reach it freely from all sides. It will dry even faster if it can be hung outdoors where a wind aids evaporation.

The class may prove this fact by wetting several small cloths and trying several ways of drying each one.

Pages 188–192. Using Thermometers. Children easily become thermometer conscious. This attitude is a good one because it emphasizes the value of accuracy. They are likely to say, "This room is too cold." "Today is a much warmer day than yesterday." "This is the coldest (or warmest) day we have had this year."

Determining the temperature by guesswork is not the best way to find out how cold or how warm a place is. More and more we need accuracy in this connection.

Most of the new stoves have oven thermometers. Many recipes call for baking in an oven at a specified temperature. Children observe their mothers as they consult the oven temperature. Many children watch the thermometer reading in an automobile to see that it does not climb too high during certain kinds of travel.

Children have very specific uses for thermometers. They need to be able to read a thermometer in order to know what clothing is suitable for them to wear, to know whether it is too cold to play out of doors, or whether the room is so warm that some ventilation should take place.

Activities with thermometers probably will not have very great variety. Children need to know how to read the thermometer. They need to know how to read it for practical purposes, such as those just mentioned. They may wish to keep a short but important record of temperature out of doors.

Some of your pupils may know how to read a thermometer

before studying this chapter. In that case they can help the others in the study of page 190. If most of your pupils cannot read a thermometer, it might be well to have this page read aloud. Throughout the reading of pages 190, 191, and 192, a thermometer should be close by to use for reference. Try to have as large a thermometer as possible so that the children can read the temperature easily. If you can have several for your group to work with, so much the better. You may have to help children to discover the fact that the degrees are numbered by 10's—10°, 20°, 30°, 40°, and so on—and that the lines between the numbers show the exact reading. For many thermometers we have to count by two's to get an exact reading. This should be pointed out to the children.

Page 192 shows thermometer readings that are important for children to know. Perhaps they can be even more informative than the book is in telling the children what they should wear or what they should do at certain degrees of temperature. Help them to see that it is important for them to take the responsibility of dressing according to the temperature. Since they know how to read a thermometer, and if they have one at home, no one should need to tell them what to wear.

Page 193. Some Things to Look For. The exercises on this page encourage children to put to their personal use some of the information which they have been acquiring about thermometers. They become aware of the importance of using thermometers under many circumstances. In addition to the situations mentioned in the text, let the children regularly observe the temperature of the classroom as it is recorded by the thermometer on the wall. Let them talk to the janitor about the uses which he makes of the classroom thermometers.

To find the answers to the questions asked in the last exercise (number 5), you may consult your local newspaper office or a local weather bureau. Perhaps some citizen of your locality keeps weather records for a hobby or in connection with his business. He probably will be glad to help the children to find out the answers to these questions.

FURTHER ACTIVITIES

In this study of air some of your pupils will go much farther in their thinking than others. These activities are included for the purpose of enriching and extending the experiences of these children.

1. Water evaporates into the air. Here are more experiments to show this. Take a pie pan, a milk bottle, a tumbler, a narrow-necked bottle, and a bottle with a stopper. Put equal amounts of water into each container. Put all containers in the same place. Look at the containers next day. Which has lost the most water? the least water? Of course the pie pan loses most water, because it has a greater surface exposed to the air. The water has greater opportunity to get into the air.

Take two containers of the same size and shape. Leave both uncovered. Put one in a warm place and the other in a cool place. Which loses water faster? "Heat makes water go into the air."

2. Try more experiments which bring water out of the air onto a cold surface. Notice drops on the outside of a bottle of milk that has been in the ice box or near the ice on the delivery truck.

Perhaps the children will say, "The moisture goes through the glass." If they do, try this: Put colored water into a glass tumbler. Put some cubes of ice in the tumbler. Stir the ice round and round. The children will see that the water in the glass is colored. The water on the outside of the glass is not colored. It could not have come through the glass. This moisture comes out of the air.

3. The fact that water comes out of the air is quite as important as the fact that water goes into the air. If water did not come out of the air, we should have no rain, no dew, no frost, no hail or snow. Let the children do some more imagining. What would the world be like if no water came out of the air? We should have no rivers, lakes, ponds, or oceans. Deserts are a good example of what happens where not enough water comes out of the air.

4. You may find that keeping records of temperature will prove to be a valuable activity. Temperature records should be purpose-

ful and important to your pupils. Do not keep a record just for the sake of giving children practice in reading the thermometer. Practice will bring desirable results only when it is purposeful.

Take the temperature out of doors several times a day for two or three days. See how the temperature varies throughout the day. Refer to the first chapter, "Day Sky and Night Sky," pp. 5–10. The book shows that noontime was warmer than early morning and late afternoon. How much warmer is your noon reading? How does the temperature recorded on one day compare with the temperature taken at the same time on other days?

Keep a temperature record for a month. What was the warmest day of the month? the coldest day? How warm was it? How cold? Ask some pupils outside the class to tell what they *think* was the coldest day and the warmest day. Compare with your figures. Were they right?

5. Find out what is meant by "above freezing" and "below freezing." Put a thermometer into a cup of melting ice. What does the thermometer read?

Find out what is meant by "above zero" or "below zero." Zero is not as cold as anything can be. Zero does not mean no heat. The sun gives the earth warmth even on a zero day.

6. Put a thermometer out of doors in the sun. Put another one in a shady place. How much higher is the red line in the thermometer that has been placed in the sun?

EVALUATION OF LEARNINGS

Good teaching does not consist only of *telling*. It does not consist only of helping children to read content. Good teaching helps children to experience and to learn as widely as possible through experience.

In evaluating children's learnings, then, you do not need to think in terms of how much children remember of what they have read. Think in terms of what children can do with what they have learned.

How well have your pupils carried out the activities described in the book? How interested have they been?

Have you made use of certain checks suggested in the Manual?

Have a quiz program. Have each child prepare a question dealing with something learned about air. The question should be written on one side of the paper, the answer on the other. Questions such as the following are good ones to consider:

Name some of the greatest air travelers in the world.

Name some air travelers that do not fly.

What are some of the ways in which the flight of birds is not like the flight of airplanes?

Suppose you are at the north pole. At what part of the thermometer should you look to find out how cold it is?

The variety of the children's questions as much as their answers will give you a measure of the learning which has resulted from their study.

Remember, content in itself is not your goal. The important thing to consider is how content is to be utilized.

MATERIALS AND EQUIPMENT

Sheet of paper to make a paper glider; dandelion, milkweed, or cattail seeds; thermometer (Do your best to obtain a thermometer on which numbers are well spaced and which show clearly. Use a large-sized thermometer); glass tumbler; narrow-necked bottle with stopper; narrow-necked bottle without stopper; pie pan; milk bottle.

BIBLIOGRAPHY

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, pp. 213–218. Ginn, 1940.

Craig, Gerald S. *Science in Childhood Education.* Bureau of Publications, Teachers College, Columbia University, 1944.

Arey, Charles K. *Science Experiences for Elementary Schools.* Bureau of Publications, Teachers College, Columbia University, 1942.

For the Children

Andress and Goldberger. *The Health Parade*, pp. 47–50. Ginn, 1939.

Booth, Harold H. *Book of Modern Warplanes.* Garden City, 1942.

Floherty, J. J. *'Board the Airliner.* Doubleday, 1937.

HORN, ERNEST, and others. "The Airplane Trip," pages 191–207 in *Making New Friends*. Ginn, 1940.
HORN, ERNEST, and others. "The Thermometer," pages 163–169 in *More Adventures*. Ginn, 1940.
HUBER, MIRIAM B., and others. *Planes for Bob and Andy*. Macmillan, 1943.
LENSKI, LOIS. *The Little Airplane*. Oxford, 1938.
LENT, HENRY B. *Flight 17*. Macmillan, 1940.
LENT, HENRY B. *Straight Up*. Macmillan, 1944.
LENT, HENRY B. *Straight Down*. Macmillan, 1944.
PRYOR, WILLIAM C. and H. S. *Airplane Book*. Harcourt, 1935.
SHENTON, EDWARD. *New Alphabet of Aviation*. Macrae-Smith, 1941.
TOUSEY, SANFORD. *Airplane Andy*. Doubleday, 1943.

FILMS

Airplane Trip Robin Redbreast Seed Dispersal

VIII. WATER FOR YOU AND ME

Water is one of the most abundant substances on the face of the earth. It is probably the most important. Most eight-year-olds think of water first in terms of themselves. They need water to drink. They must have water for baths. Their mothers use water for washing clothes and for many other household purposes.

But a study of water goes beyond these experiences. Water is one of the great natural resources. Eight-year-olds can begin to have understandings of this truth. A study of water is really a study of the community. Children can learn from observation how plants and animals in their community are affected by water or by the lack of it. Perhaps they can observe well-watered gardens and compare the plants there with uncared-for weeds struggling for growth in a vacant lot. Perhaps they can observe for themselves how dependent farm animals are upon the water which the farmer makes available to them.

These children can learn something about the water that comes into their homes. Where is the source of this water? Is this water clean and pure? Perhaps they can learn something about how this water is purified.

Perhaps they can observe bodies of water. There may be a near-by large lake or river which affects the living of the whole community. Perhaps a few wells or a small creek constitute the only bodies of water in the vicinity. However large or small the body of water is, plants and animals and usually people are in some way influenced by it.

Increased consciousness of the nature and activity of water should be a salient part of the growing-up processes of children. What are some of the ways by which we can help them to interpret this important portion of their environment?

PURPOSES

We can help children to interpret this important part of their environment by considering the following purposes:

Water is one of the most important substances on the earth.
Water is necessary to life. It is used in countless ways.

Water is found on all parts of the earth—in the air, on the surface of the earth, under the ground.

Our bodies need water.

Plants, as well as animals, must have water.

Water helps our way of living. Since earliest times, man has used water as a means of travel. Man has learned to make water work for him.

Too much water can interfere with man's ways of living.

Man has developed good ways of carrying water to places where there is a scarcity of it.

Many things will dissolve in water; many things will not dissolve in water.

GUIDING PUPILS' STUDY

Pages 195–197. Water Is Useful. In this section of the chapter an attempt has been made to help children to acquire a sense of the importance of water. Help them to realize that wherever they go, wherever they look, they will find water, if only in their own bodies.

After reading these pages, your pupils will need the opportunity to develop fuller meanings. Look out of the window. See if you can find any of the ways in which water affects your life. You may see rain or snow. How are these important to you?

When you go out for play period, take a walk around the schoolyard. If your school is in a small town or rural area, you can readily see how plant life is affected by water. Perhaps things are very dry. Then you have further evidence of the interrelationships between plants and water.

Do you live in a part of a big city where not even a blade of grass can flourish? You still are affected by snow and rain. Close to your school you should find a water hydrant. Your children can appreciate the use of water as it is related to public safety, especially in case of fires.

Now you are ready to consider the last paragraph on page 197. Give the pupils an opportunity to think seriously about this paragraph. Count the ways in which you use water. Write on the blackboard the list which the pupils enumerate.

Perhaps the children will prefer to make individual lists. You can use these lists for a chart entitled "We Use Water in Many Ways."

Experiences such as these help to point out that living things are dependent on water at all times; that they are never completely detached from it.

Page 198. Water in the Air. As the children read page 198, they will recall their study about water in the air in the preceding chapter. They may be interested in naming other places which give up water to the air. However, repeated use of the plan of "finding other ways" can become somewhat tedious and so defeat its purpose. A good teacher does not overwork a technique of study.

Children may do well to consider other forms of precipitation. The term *precipitation* denotes any form of water which comes to the earth through the air. Snow, hail, and sleet are other forms of precipitation. The snow, the sleet, and the hail eventually melt and drain into the ground.

Dew and frost are thought of in connection with water in air. Moisture in the air condenses as dew and soon evaporates into the air. For a clear explanation of the phenomena of snow, sleet, and frost, consult the following reference: Craig, *Science for the Elementary-School Teacher*, pp. 220–224.

As a background for helping children in this part of the study, the teacher needs to review her own concept of what is called the water cycle. The sun causes water to evaporate into the air. Air currents cause the water to condense. Gravity causes the water thus condensed to fall to the earth as rain, sleet, or snow. Then the process takes place all over again. This is termed the water cycle.

Page 199. Water on the Earth. What an abundance of water is on the surface of the earth! Let the children consider long journeys which they may have taken on land. Describe the length of time these journeys required. The land part of the earth covers a vast area. Now study the map at the foot of the page. The

land part of the earth is small compared with the water part. Water covers three fourths of the surface of the earth.

Oceans are the largest bodies of water on the earth. Further than that, there is no need to have the children differentiate between different kinds of bodies of water.

If one or more kinds of bodies of water are in your community, visit one if possible. Your purpose here will not be to find out why this is a lake or that a river, but to get a sense of the vast amount of water in the body of water which is visited. An enormous quantity of water runs through even a tiny brooklet during a day. Study with your pupils how the community is affected by this body of water. Perhaps your body of water is so large that most of the industry in the community depends on it. Perhaps there is only a tiny stream or pool of water. The lives of *some* plants and animals are affected by it.

In visiting such a body of water, take note of the bank of the stream or river, or the shore of the lake. What will happen when prolonged heavy rains come? Will the body of water overflow right away? Or is the bank high enough to hold much more water within its bed? If you are visiting the body of water during a dry time of year, try to find out how high the water was during the very rainy or flood time of the year. Try to find out how low the water was at a very dry time.

Change is constantly taking place on the earth. Children have some concept of this change as they observe the effects which the water leaves on the bank of the stream or on the shoreline of a lake. They are aware of changes as they consider that sometimes the brook is full to overflowing and sometimes the water line is very low.

Page 200. Water in the Ground. Children who have some contact with wells know that there is water in great quantity within the earth. Most eight-year-olds have not had this experience, however. Therefore the idea that water in quantity may be found under the ground is difficult for many children to understand.

Soil with no moisture is rarely found. Try these experiments to show that there is moisture in the soil:

1. Find a garden plot that looks very dry. Dig down into the ground. How far must you dig to find the dark soil in which you can feel moisture?

2. Put a quantity of dry soil into a pan. Place a tight cover over the top of the pan. Put the pan on the stove. Heat slowly. After a time, look at the inside of the cover. Tiny droplets of water will have formed on the inside of the cover. Where did they come from if not from the soil?

Help your pupils to learn to think of water as being always in motion, as being pulled down by gravity to flow somewhere. When rain falls to the earth, a part of it flows into creeks or rivers which eventually reach a large body of water. Part of it runs down into the soil, where it adds to the supply of subsurface water already in the ground. Some of this subsurface water may later emerge at a spring or well. The spring water too drains over the ground until it joins a larger stream.

Much of this water does not stay under the ground. Some of it eventually reaches the sea. Some of it is thrown off by plants. Some of it is brought up to the earth by wells. Some of it appears above the earth as swamps and springs. Water is caused to be always in motion either by evaporation or by gravity. Water is in the air; it is on the ground; it is under the ground.

Pages 201–203. Water in Our Bodies. About two thirds of the body is water. Just suppose that we could live on without any water in our bodies. They would be quite different from what they are now. We would weigh much less. Try to find out how much you would weigh if all water could leave your body.

We take water into our bodies in many ways. Let the pupils name various liquids which put water into our bodies. People and other animals can get along without food much longer than they can without water. Our bodies constantly throw off water, and this water must be replaced. We get thirsty much more quickly on hot, dry days than we do on rainy days, because our bodies give off water much more rapidly when the weather is hot and dry.

Evaporation is a cooling process. The perspiration which evaporates into warm, dry air keeps our bodies at a fairly com-

fortable temperature. We are most uncomfortable on the hot, humid days of summer. This is because the perspiration cannot evaporate so well when the air contains a large amount of moisture.

The experiences throughout this chapter give opportunity for the development of health meanings. In this section cleanliness comes in for attention. On hot days most children want to swim, to play in water, or to take baths. Of course the cool water helps to keep the body cool. Cleanliness in itself is cooling to the body.

There are many ways by which people adapt themselves to loss of water from their bodies. We try to stay in a cool place. We take liquids into our bodies. We try not to be overactive. We read on page 203 how other animals keep moisture in their bodies in hot weather. People think and plan how to keep their bodies cool in warm weather. Other animals do not think and plan.

Pages 204–205. Water in Plants. Wherever we go, wherever we look, water in some form is near at hand. It is in the air. It is on the earth. It is in the ground. Water is in the bodies of animals. It is also found in plants.

A child who has assumed responsibility for the care of plants realizes that a very great amount of water is taken in by most plants and that this supply must be constantly replaced. The reason for this is twofold. Plants must hold a certain amount of water if they are to survive. They also give off water into the air.

The book presents a number of experiments to show that plants hold water. Rubbing the wet side of a potato along a glass, as described on page 204, should leave a wet smear on the glass. This smear is shown in the picture. The experiment on page 205 can be turned into reverse. Take some commercially dried apples. Note their dried and shriveled appearance. Put them to soak in water overnight. See how much thicker each piece becomes. How much more like a piece of fresh apple it looks than it did the day before!

Look at the stems of a plant. Can you see water in them? Moisture is found in the stems of most plants. Note the "milk" in milkweed stems and stems of dandelions. Stems of nasturtiums hold much water. The sap in maple trees and the resins in ever-

green trees show the presence of water in plants. Cactus plants hold much water. Travelers in the desert have been known to cut open certain varieties of cactus in order to drink the water. Plants constantly give off water into the air. A sunflower is said to give off a pint of water in a day. A large tree is said to give off as much as a barrel of water in a day.

To show that plants give off water, try these experiments:

1. Place freshly cut leaves in a bottle. Put a stopper in the bottle. Small drops of moisture will soon collect on the inside of the bottle.

2. Place a dry glass jar over a begonia or other small plant. Leave it in the sun. Watch drops of water collect on the inside of the jar. These drops of water come from the plant.

Perhaps the pupils will think the moisture on the glass comes from the moist earth. In that case cover the earth in the jar with a piece of blotting paper. Do the drops of moisture still form on the inside of the jar?

As you live through these experiences with your pupils, remember that you are trying to help them to grow in awareness of the dependence of plants upon water—that water is one of the conditions essential to the life of plants.

Pages 206–209. When Water Is a Help. In many ways man has made use of water to improve his ways of living. Since earliest times he has used water as a means of travel. From faraway places he has brought new kinds of food, new textiles, new ideas, and new ways of living.

Some pupils will probably ask questions about the queer-looking ship at the foot of page 206. You will interest them by telling the story of the northmen who built vessels like the one pictured and about the year 1000, centuries before Columbus's time, under their leader Leif Ericson, discovered North America, which they named Vinland.

Man has harnessed waterfalls to provide water power and electric power. He has changed the courses of streams, built dams, and made great waterfalls where they did not exist before.

Communities in many parts of the earth are benefiting from such construction. The picture at the top of page 207 shows waterfalls outside a generating plant. Is there such a development in your vicinity? Many places receive power from such developments, which are many many miles away. Perhaps this is true of your community. You can write to the United States Government Printing Office, Washington, D.C., for a booklet of publications related to water power and irrigation projects. Excellent pictures illustrating water power are to be found in the Visual Curriculum Series, published by the Creative Education Society, Mankato, Minnesota.

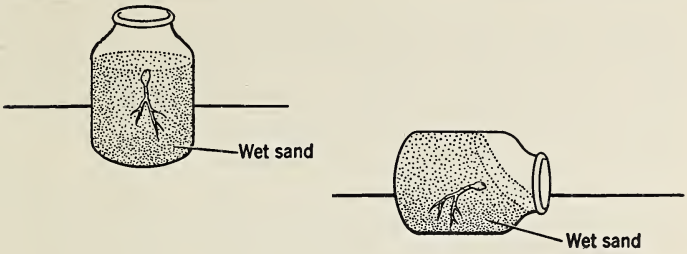
Most children have observed the power of steam in one use or another. A very young child talks about the boiler of a steam locomotive. He has watched the bobbing cover of a pan in which water is boiling.

The power of steam as a driving force is illustrated by the following experiment. Take a small tin can—an olive-oil can of pint size works very well. Put water in the can up to about one inch. In the opening at the top place a cork. Stopper it loosely. When the water boils, watch for the cork to be blown from the opening. The cork may be blown as high as the ceiling by the force of the steam. See that the pupils stand well back from the can, as the steam which follows the cork into the air may condense into very hot rain.

Water is a means of conserving much of our wild life. After your pupils have read page 208, encourage them to tell some of the things they know about the kinds of wild life which are benefited by the waterways in your community.

Page 209 calls for specific teacher guidance. The illustration shows roots of plants reaching out for water. The plant at the margin of the page with the long roots reaching down is an alfalfa plant. Note how the roots of the plants in the box have grown out of their natural direction way out to the right. They are reaching for water. Plants must have water.

Try other experiments of this sort. Place wet sawdust or sand in a jar. Plant radish seeds or other small seeds close to the glass so that they can be seen through the glass. As roots form, they



will point down. Tip the jar over on its side so that moisture goes to a different place in the jar. In a short time, the roots will grow in the direction of the water.

The roots of many plants in desert regions spread over a wide area to reach water. Creosote bushes grow far apart. The roots reach out horizontally near the surface of the soil. They are ready to take every bit of water that falls on the ground near them.

Pages 210–211. When Water Does Not Help. Activities connected with these pages should be those which children observe.

After a hard rain children can observe soil which has been washed away from school grounds or from people's yards. Often sidewalks are coated with mud that has been washed from near-by yards and gardens. Children can note rubbish which is washed near the drains and into gullies by a hard rain.

Their observations may lead the pupils to see also that soil washes away much more quickly where there is no thick growth of plant life than it does in places where trees, shrubbery, and grass are thickly planted.

These observations help to increase meanings which a child has in regard to changes that are going on in his environment. They may lead him to realize that the community has a responsibility to help prevent some of the changes which are destructive.

Pages 212–214. Getting Water to People Who Need It. Help the children to follow, in imagination, a cup of water from the faucet in their homes back to the place where it first began to be called drinking water.

Many children live on farms where their drinking water is procured from a well. The mechanics of drawing water from a well are fairly simple, especially if it is of the old-oaken-bucket variety. An electric pump which pumps water from a well to the house is illustrated on page 150 of the text. These children do not have to follow their cup of water very far.

The water which people use in most cities or towns travels some distance. This water may come from one or more reservoirs. It may come from a river. Help the children to find out about the source of their local water supply. In small towns most children have had the opportunity to see the reservoir. Try to find out what feeds the reservoir. Let them find out what they can about how the water is purified. In some places there is a strong taste of chemical in the water. The chemical has been put there to kill germs. "Dirt," as children would call it, is removed by a screening process.

In large cities the water system is much more complicated. Often the source of supply is miles away from the city. In some instances the children will need help to gain any concept of the distance that the water travels to reach them. Measuring this distance in the length of time it would take a person to travel to the reservoir will give children a rather definite idea of how far away the reservoir is. Reservoirs are carefully guarded to see that all equipment is in order. Usually an elaborate program of planting has been carried out to help conserve the water supply.

Children who have experienced irrigation on farms need little explanation beyond the book's description. Pictures showing various types of irrigation can be shown, but a further study of these is complicated and is not appropriate at this grade level. Children who have not had personal experience with irrigation cannot have a very full concept of it. The emphasis here is on the fact that man has done much to get water to places where it is needed. He has made it possible for farms to flourish where the good soil formerly was of little use.

Pages 215–216. Where Does the Salt Go? In this part of the chapter the pupils learn by trying. As they read, they find many

questions, but few answers. They must experiment to find out. Do not try to do their thinking for them. Let them learn through their own experiences.

As the children experiment, they will learn that some substances dissolve in water, that other substances do not dissolve in water, and that things which do dissolve in water become a part of the water.

Children can use these learnings in further understanding of their environment. Many children have tasted the salt water of the ocean. They know that salt is dissolved in the water.

On a rainy day put a pan out of doors to catch some of the rain that falls. Let the children taste this water. How different the taste is from that of well water or of water which comes from a reservoir! Practically no foreign matter has been dissolved in the rain water which they have caught in the pan. It has a strange, flat taste. Let the pupils try to find out why this water tastes so different from their regular drinking water. The teacher will know, of course, that minerals from the ground have been dissolved in their drinking water.

Page 217. Find Out by Trying. The purpose of this exercise is stated in the first sentence, "Try to find out more about dissolving things in water."

Paper does not dissolve in water. It will lose its identity as a sheet of paper when it is left in water, but it does not dissolve.

Sand does not dissolve in water. It does not float.

Oil does not dissolve in water. No matter how much it is stirred around in the water, it always comes to the top again.

EVALUATION OF LEARNINGS

This chapter calls for study that is truly active. It is not the type of study in which the book is the major source of their information. It is true that the pupils read the book to gain information, but they read also to set up problems of learning. Much of this learning comes from doing, seeing, asking, thinking.

As a part of her evaluation of pupil growth, the teacher might do well to stop a bit and evaluate her own teaching.

Has she given children the opportunity to make observations of their own? Has she helped them to think out problems for themselves? Has she encouraged critical thinking?

How has this come about? Has the teacher encouraged children to say, "I don't know. How can we find out?" Has she been willing to say this herself when her own knowledge has been insufficient for the adequate working out of a problem?

Has the teacher made all possible effort to clear up problems arising in pupils' minds? Has she helped them to use available resources? Has she helped the pupils to consult people in the community who can give authoritative answers to their questions? In this study the person who holds the position of water commissioner might serve as a consultant.

Has the teacher encouraged *all* the pupils to think and to experiment? Occasionally a pupil who has seemed inactive and uninterested for a long time begins to display real interest in and considerable knowledge of science experiences. Is the teacher watching children of this sort, helping them to build up a readiness for learning in this field?

Some pupils will go much farther in their thinking than others. These pupils should have the opportunity to fulfill their interests at this level. The additional activities suggested by the Manual will serve to occupy these inquiring minds.

Two additional activities are suggested here as concrete means of partial evaluation of pupil learnings:

1. Make picture maps which trace the travels of a cup of water from reservoir or well to the faucet in your house. This map will not be drawn to an accurate scale, of course. If the reservoir is many miles from your town, include a statement of this distance in round numbers.

2. Make a chart entitled "Things I Have Learned about Water."

MATERIALS AND EQUIPMENT

Small pan with cover; large-necked bottle with cork stopper; glass fruit jar; commercially dried apples; potato; two or three

medium-sized plant jars containing soil; small plant in jar; small tin can with stopper (A pint-sized olive-oil can will do); wet sawdust or wet sand.

BIBLIOGRAPHY

For the Teacher

CRAIG, GERALD S. *Science for the Elementary-School Teacher*, pp. 91–94, 212–220, 260–262. Ginn, 1940.

CRAIG, GERALD S. *Science in Childhood Education*. Bureau of Publications, Teachers College, Columbia University, 1944.

CROXTON, WALTER C. *Science in the Elementary School*. McGraw-Hill, 1937.

For the Children

ANDRESS, J. MACE, and others. *Growing Big and Strong*, pp. 16–17, 182. Ginn, 1945.

FENTON, CARROLL L. and M. A. *The Land We Live On*. Doubleday, 1944.

MELROSE, MARY, and others. *My Land and Your Land Conservation Series*. National Wild Life Federation, Inc., Washington, D. C., 1944.

FILMS

Work of Running Water[1] Gardening Roots of Plants

[1]This film is somewhat advanced in comparison with the text, but may be useful for some groups.

IX. HOW LONG IS A LIFETIME?

Throughout the study of *Science Every Day* your pupils have been learning about the ways in which animals and plants live and grow. Three of the chapters deal with this theme in their entirety.

Each of the other chapters (except the one on magnets) has developed meanings on some aspect of the life development of animals and plants. The extent of the influence of the sun, moon, and stars (first chapter) upon living things is beyond measure. Air (seventh chapter) and water (eighth chapter) are essential to the continuance of life upon the earth. Electricity (sixth chapter) has made improvements in ways of living and in transportation and communication.

This chapter, "How Long Is a Lifetime?" presents a new concept in regard to the life and growth of living things. This is the concept of the passing of time. It is a concept into which children's understanding grows very slowly. Maturity is needed for really adequate understanding of it. Probably no one ever reaches the stage in life when time is fully comprehended. The concept of time becomes more real when it is considered in terms of the lifetime of living things. The emphasis in this chapter is upon the very great variety that is found in the life span of living things.

As you read the text in preparation for guiding the learning of your pupils, plan how you will give them opportunity to do their own thinking. The concept of time will develop slowly; it will develop through experience.

PURPOSES

It is the purpose of this chapter to develop the following concepts about the life of animals and plants:

Some animals grow up quickly; others take a long time to grow up.

Some plants live only one year. These are annuals.

Some plants live indefinitely. These are perennials.

Many plants (annuals) die in autumn.

Although perennials live through the winter, they do not make food during this period of cold.

Many plants produce seeds by means of which more plants are produced.

Perennials, as well as annuals, produce seeds.

Seeds produce the kind of plant from which they have come.

Plants need air, water, and light in order to grow.

Life is persistent among all kinds of living things.

GUIDING PUPILS' STUDY

Pages 219–224. Lifetime of Animals. This chapter gathers together the meanings developed in most of the preceding chapters and puts them to use in the development of further meanings. The pupils will recall the life stories of several kinds of animals as they were described in the second chapter, "How Some Animals Live and Grow."

Perhaps you will want to ask the pupils to turn to this chapter in their books. Review some of the pictures. Give the pupils an opportunity to reread some of the things about which they are particularly interested.

The children will remember that each kind of animal lives through a certain kind of lifetime. It is born—either hatched from the egg or born alive. It lives through its life, its greatest problem being to stay alive. It procures food; it eats and digests this food. It escapes its enemies. It meets stormy weather and winter's cold. It carries out these processes according to its adaptations. If it is well adapted to meet the problems of living, it survives.

These are old meanings. They are foundational to new meanings. Some animals grow up very quickly. They go through their life development in a short time. Other animals need a long time to grow up. A long time is required for their life development to take place.

There is a wide variety in the life patterns of the animals of the world. With some animals there is a very short period of infancy. Young aphids (plant lice) are like adults almost as soon as they are hatched from the egg. Except for size, the young of most kinds of fish and reptiles are like adults. They go through all the life processes with no guidance or protection from

the parents. Mallard ducklings, young jack rabbits, and many other kinds of birds and mammals can move about as soon as they come into the world. They stay with the parents only a short time and grow to adult size in a much shorter time than is required for birds and mammals which are helpless at birth. They spend the greater part of their lives as adults.

Other animals have a prolonged youth or immature stage. Frogs spend from three months to two years as tadpoles before they become adult frogs. Butterflies and moths spend a great part of their lives in an immature stage.

Other animals have a very short adult life in proportion to the time spent in an immature stage. May flies (see page 221) live in an immature stage for about two years. The adult stage lasts for only a night. Most moths have poorly developed mouth parts. Because they cannot take in food, they live only long enough to lay eggs. Then their life is ended.

The length of life span does not always denote a long period of infancy. Of the long-lived animals mentioned in the text, parrots have a short period of dependence upon parental care in proportion to their long life. Turtles have no period of infancy from the standpoint of need of parental care. The higher mammals, however, have a longer period of helplessness than other animals have. They receive parental care for a much longer time. Young elephants stay with the herd of female elephants for three or four years. A female elephant begins to rear young at about the age of ten years. With human beings, the period of parental care lasts longer than that of any other species. In some respects, this period lasts until the individual is well along in adult life.

After the pupils have read pages 219–224, discuss page 224 very carefully. Then you might bring about a discussion of some of the meanings given above. You might start your discussion by presenting a problem such as this: There are different stages in the life of people. There is the time when the person is a baby. This is called infancy. There are the growing-up years. Then the person is grown up. A grownup is called an adult. Does the lifetime of other animals follow this pattern?

Discuss specific animals with which the children are familiar.

To make your meaning clear, you might work the facts into a blackboard chart similar to the following one.

NAME OF ANIMAL	INFANCY	GROWING UP	ADULT
Turtle . .	Almost none. Moves about as soon as it comes out of the egg. No care from the mother	Grows larger, but does not change much in the way it looks	Grown up after five years. May live for thirty or forty years
Cat . . .	Helpless for about nine days. Has care from the mother for from two to three months	Grows larger, but does not change much in the way it looks	Full-grown in about one year. May live for eight or ten years
Frog . . .	Moves about as soon as it comes out of the egg. No care from the mother	Great change in the way it looks. Parts of body are not the same in the adult as they are in the infant stage	Becomes an adult in from three months to two years. May live for eight or ten years
Robin . .	Helpless for about one week. Has the mother's care for about two weeks	Grows larger. Grows feathers. The parts of the body are the same in the adult as in the infant stage	Adult in about four weeks. May live for several seasons

The teacher should not do the thinking for the pupils here. The children should provide the information for this chart.

Discuss the lifetime of people. Discuss the care which the children receive from their parents. Let the children tell how their parents will help them when they are in high school or in college. Bring out the fact that parental influence is felt throughout the life of the individual.

Page 224. Something to Think About. This exercise, like others, is to encourage reflective thinking concerning the generalizations which have just been taught. The lifetime of animals varies greatly, according to the species.

Pages 225–230. Lifetime of Plants; Perennials in Winter. Your children have been studying about the lifetime of animals. The lifetime of some animals is very long. For some it is very short. Is the lifetime of plants like this? Do some kinds of plants have a long lifetime, while other plants have a lifetime that is very short?

As the children read to find out the answers to these questions, they learn two new terms, *annual* and *perennial.* The annuals shown in the picture on page 225 are (across page) zinnias, petunias, cosmos, and poppies. The tomatoes, beans, and peas, shown in the picture on page 226 are also annuals. You can turn to a good seed catalogue to find lists of many more annuals. "Those plants which germinate from seed, grow, blossom, produce seeds, and die within a single year are known as annuals."[1]

The perennials shown in the picture at the top of page 227 are peonies, bleeding hearts, madonna lilies, and irises. The weeds shown at the bottom of the page are also perennials. They are dandelion, plantain, smartweed, and burdock. The picture on page 229 shows a dandelion, a violet, and a grass.

"Still other plants live for a number of years and produce seeds each year after they mature. They are known as perennials. Trees, shrubs, and many herbs are examples of perennial plants."[1]

The trees described on page 228 are the trees in the great redwood forests of California.

Some plants require two years to grow from the seed and produce seeds themselves. These are known as biennials. Beets, carrots, hollyhocks, and winter wheat are examples of the biennial type of plant. This type has not been included in the text. Confusion would probably result from presenting to eight-year-olds a type which has characteristics of those already presented

[1]Gerald S. Craig, *Science for the Elementary-School Teacher*, p. 342. Ginn, 1940.

but which is in a separate category. Biennials are mentioned here to answer the question likely to arise in the minds of many teachers, "But what about biennials?" The definitions of annuals and perennials are also for the information of the teacher. They are not to be memorized by the pupils.

The meaning emphasized in pages 225–228 is this: "There is variety in the lifetime of plants."

In guiding the children's study of pages 229 and 230, the teacher should have a good foundation of knowledge on the subject of food storage in plants. Read Craig's *Science for the Elementary-School Teacher*, pp. 342–348, for this information. For background to the study of page 230 in the text, read pages 350–352 in the same book.

It is important for children to know that perennials, as well as annuals, grow from seeds and have seeds of their own. In the spring, observe the blossoms on many kinds of trees. The blossoming apple, cherry, and other fruit trees are familiar to most children. The blossoms on maple, horse-chestnut, dogwood, and magnolia trees are also familiar to many children. Tiny seedlings are often to be found under maple, oak, sycamore, or other trees. Many times the seed case is attached to the root of the young seedling. If your pupils can examine these, they will have some understanding of the fact that perennials, as well as annuals, grow from seeds.

It may be possible for your pupils to examine the seeds of perennials in the garden. Open the seed pods of the peony or iris. Probably the seeds in these pods will not be ripe enough to plant before school closes in the spring. However, planting such seeds might carry over into a fourth-grade activity.

Pages 231–235. What Plants Need to Grow; Why Does It Happen? To understand the conditions necessary to the life of plants, the children must have the opportunity to care for plants themselves. Reading these pages is not sufficient.

If the pupils are already caring for schoolroom plants, they will find verification of their own findings in these pages. If you are opening up the problem of caring for plants, these pages will

serve as a guide to the knowledge of what plants need in order to grow.

Try the experiment described at the end of page 233. Let the children find out for themselves that plants need light.

In the pictures on page 232 the following plants are shown: coleus and begonia; cactus plants; water plants—ludwigia, vallisneria, sagittaria.

On page 233 the plants shown are a geranium and an African violet. The dying plant is also an African violet. Even an African violet, which grows best in a north window away from bright sunlight, will not flourish in a dark closet. It must have light.

On these pages the idea of variety is again brought out. There is variety in the kind of air in which plants thrive. Some plants, such as orchids, cotton, and corn, need very warm air. Other plants grow better in cool air. Some plants need much water in order to grow. Other plants need little water. The same thing is true regarding plants and light. But all plants need *some* air, *some* water, and all but a few kinds of bacteria need *some* light.

Pages 234 and 235 are "doing" pages. Examine the diagram of the life cycle of the bean seed, but do not feel satisfied that adequate learnings will be brought about through the pictures alone. Give your pupils an opportunity to *watch* the cycle of a bean plant or some other kind of plant.

With sufficient warmth, a string-bean plant will grow to full maturity in about two months. Before planting the beans, soak them overnight. They will swell up to much more than their previous size, and the seed coat will slip off easily. Examine the inside of a few of the seeds with a magnifying glass. The embryo plant will show clearly.

Plant some of the bean seeds in a jar of good soil. To watch the first emergence of the young plant, start a few of the other seeds in water. Take a drinking glass and crumple a paper towel into it. Put the bean seeds around the side of the glass so that they can be seen through the glass. The paper towel will hold them in place. Put enough water in the glass to keep the paper moist. Look at the seed leaves and the root. Later you can watch the full growth of the bean plant that is growing in the jar of soil.

Throughout this chapter and in other chapters which treat of the growth of plants the thought of the persistence in the life of plants asserts itself. On page 209 in the preceding chapter, we saw the roots of plants reaching out for water. In carrying out the activity on page 235 of the text, we discover plants where apparently there was no plant life.

We see tall trees in the forest growing up above other growth in a search for light. Life in the jungle is the survival of the fittest. Vines strangle many trees, using their nourishment and climbing above them to get light for themselves. On every hand we see the struggle for life.

Your pupils may find examples of this. They will discover plants growing in the small portion of earth in a rock garden, a tree growing on a narrow ledge of rock, and weeds springing out of the impoverished soil in vacant lots.

We find this persistence in the grass which springs up in the desert after a rain and covers great areas. When the dry time comes again, the grass withers, but seeds and roots stay within the ground ready to sprout into plants when the rain comes again. We see it also when the warmth of the spring sun starts the quick growth of grass and flowers in the tundra at the edge of the snowy regions of the north.

This persistence of life is equally characteristic of animals. It was stated on page 107 of the Manual that this chapter pulls together meanings developed in other chapters and points out new meanings. At this point, let us look to other chapters to bear out the thought of the persistence of life.

The third chapter, "Many Ways to Live and Grow," by its very nature shows that survival is not easy for animals. Many animals survive because they can live on so little; they persist in living. For mountain goats and bighorn sheep, food is very scarce, and what little there is, is hard to find. Think of the musk oxen feeding on the grass of the tundra, the caribou making a living in the barren winter of the north, or desert animals requiring and receiving a minimum of food and water.

Life is difficult, but living things persist in holding on to it.

Pages 236–241. A Tree Grows Up. Persistence of life is shown throughout this story. It also develops further the concept of time, which is one of the themes of this chapter. To many children, the lifetime of trees and other perennials is "without beginning and without end." To them, the trees about them have always been where they are now. Their concept of time is undeveloped. Things that happened before they were born lack sequence; they lack proportionate relationships in the time element.

Pages 242–243. Other Lives. The exercises at the end of the chapter are designed to aid children's understandings of the design of life. In this final discussion the purpose is to give the children a glimpse of their responsibility to the adequate rounding out of their own life cycle.

1. In many towns and cities the shade trees are sprayed to destroy insect pests. Farmers spray their fruit trees regularly. Let the children discuss and, if possible, observe these activities. If any children have watched tree surgeons at work, let them tell about it. Try to find a tree with a hole that has been filled.

4. Let the children discuss health habits. A summary of rules for a long lifetime might be written on the blackboard.

EVALUATION OF LEARNINGS

Some teachers like to think of measures of children's learning first in terms that are tangible. They want some material evidence of the learning that has taken place. Such measures as the following are suggested.

By the end of their third school year, pupils should be able to do some very simple composition. Ask your pupils to write in a few sentences their answer to the question "How long is a lifetime?"

See if they can summarize meanings, such as "The lifetime of some animals is very long; for some animals it is very short." Remember that the meanings listed under "Purposes" are recorded to help the teacher and are not to be memorized by the pupils. On the other hand, if the pupils can make some of

these generalizations *for themselves*, you can conclude that learning has truly taken place.

The close of this final chapter seems an appropriate place to take inventory of interests and attitudes that have developed through the children's study of science. You will want to ask yourself, "What attitudes and interests have developed? How have these attitudes and interests affected the children's behavior?" In answering these questions, consider the following points:

1. Have the children's interests in science broadened? Have those who were interested only in animals become more interested in plants or in physical science? Have those pupils whose interests were centered upon electricity and other aspects of physical science become interested in the life and growth of animals and plants?

2. Is there an improved attitude toward certain living things? Is there more respect and less disgust toward creeping, crawling things, such as slugs, snakes, and caterpillars, and certain other creatures like mice, toads, and frogs? Do the children seek to find out more about the ways these animals live instead of turning from them with a shudder or with the exclamation, "Ugh, kill it!"

3. What attitude do the children show toward the opinions of others? Are they willing to have their own ideas challenged or questioned? Are they able to defend their ideas logically and objectively when they are challenged? Are they the victims of gullibility, accepting information offered by anyone whether or not it is reasonable or reliable?

4. Are the pupils satisfied with their own explanations, or do they seek the opinions of others to substantiate their own thinking? Are they eager to find out the *right* answers to their questions?

5. Do they take the attitude that there is much more for them to learn about the subjects which they have studied?

6. Are they satisfied to realize that there are some things which scientists cannot explain at present in their entirety? "What is

life?" is one of the questions in answering which scientists might say "Probably" or "We believe," but would not give a positive answer. See Craig's *Science for the Elementary-School Teacher*, pp. 56, 57, 60.

How does a teacher know whether or not these attitudes exist? How is she to know which children have which attitudes? Subjective judgment must be depended upon to a very great extent. Many teachers, however, do not wish to rely entirely upon personal opinion with no material basis for judgment. They prefer to rely upon pupil records.

Keep a notebook with a page or two for each pupil. Write a brief account of important incidents soon after they happen. In just a few sentences make note of important discoveries, of increased interest, or of improved attitudes. For some children there may be a reiteration of "No change in A's attitudes. What can I do to awaken interest?" This running account can serve as a foundation for your judgment of pupil attitudes and interest.

MATERIALS AND EQUIPMENT

Two or three medium-sized plant jars filled with soil; bean seeds; two or three glass fruit jars; paper towels; a tree box (A tree box is a box filled with soil at least six inches in depth in which children may plant tree seeds. Grapefruit, orange, apple, peach seeds, or acorns are suggested. Young trees in their first season of growth may be planted in this box and will perform their functions of losing leaves and growing new ones in the spring if all goes well. When the trees grow too large for the box, they may be planted out of doors).

BIBLIOGRAPHY

For the Teacher

Craig, Gerald S. *Science for the Elementary-School Teacher*, Chap. X, pp. 342, 347, 350. Ginn, 1940.

Craig, Gerald S. *Science in Childhood Education.* Bureau of Publications, Teachers College, Columbia University, 1944.

Hegner, Robert W. and Jane. *Parade of the Animal Kingdom.* Macmillan, 1935.

For the Children

GATES, ARTHUR I., and others. "Seeds," pages 174–182 in *On Longer Trails*. Macmillan, 1945.

HUNTINGTON, HARRIET E. *Let's Go Outdoors*. Doubleday, 1942.

LIMBACH, RUSSELL T. *American Trees*. Random, 1942.

MATSCHAT, CECILE H. *American Butterflies and Moths*. Random, 1942.

MCKENNY, MARGARET, and JOHNSTON, E. F. *A Book of Wild Flowers*. Macmillan, 1939.

MCKENNY, MARGARET, and JOHNSTON, E. F. *A Book of Wayside Fruits*. Macmillan, 1945.

PARKER, BERTHA. *Seeds and Seed Travelers*. Harper, 1941.

PROCTOR, G. D. *A Picture Almanac for Boys and Girls*. Lowe, 1943.

PROCTOR, G. D. *A Picture Book of Nature*. Lowe, 1944.

SMITH, NILA B. "The Yucca Plant," pages 227–231 in *From Sea to Sea*. Silver, 1945.

WEBBER, IRMA. *How Plants Go Places*. Scott, 1943.

WEBBER, IRMA. *Travelers All*. Scott, 1943.

WEBBER, IRMA. *Up Above and Down Below*. Scott, 1943.

YOAKAM, GERALD, and others. "Seed Travelers," pages 216–220 in *The Laidlaw Basic Reader, Book Three*. Laidlaw, 1940.

FILMS

Butterflies Snapping Turtle Plant Growth

List of Publishers

APPLETON. D. Appleton-Century Company, Inc., 35 West 32d St., New York, N. Y.

BECKLEY. Beckley-Cardy Co., 1632 Indiana Ave., Chicago 16, Ill.

BLAKISTON. The Blakiston Company, 1012 Walnut St., Philadelphia 5, Pa.

CORDON. The Cordon Co., Inc., 386 4th Ave., New York.

DAY. John Day Co., Inc., 2 West 45th St., New York, N. Y.

DOUBLEDAY. Doubleday, Doran & Company, Inc., 14 West 49th St., New York 20, N. Y.

FARRAR. Farrar & Rinehart, Inc., 232 Madison Ave., New York, N. Y.

GARDEN CITY. Garden City Publishing Company, Inc., Garden City, N. Y.

GINN. Ginn and Company, Statler Building, Park Square, Boston 17, Mass.

HARCOURT. Harcourt, Brace and Company, 383 Madison Ave., New York, N. Y.

HARPER. Harper & Brothers, 49 East 33d St., New York, N. Y.

HEATH. D. C. Heath and Company, 285 Columbus Ave., Boston, Mass.

HOUGHTON. Houghton Mifflin Company, 2 Park St., Boston, Mass.

KNOPF. Alfred A. Knopf, 501 Madison Ave., New York 22, N. Y.

LAIDLAW. Laidlaw Brothers, Inc., 221 Fourth Ave., New York 3, N. Y.

LOTHROP. Lothrop, Lee & Shepard Company, 419 Fourth Ave., New York 16, N. Y.

MCGRAW-HILL. McGraw-Hill Book Company, Inc., 330 West 42d St., New York 18, N. Y.

MACMILLAN. The Macmillan Company, 60 Fifth Ave., New York, N. Y.

MACRAE. Macrae-Smith Company, 225 South 15th St., Philadelphia 2, Pa.

MESSNER. Julian Messner Inc., 8 West 40th St., New York 18, N. Y.

OXFORD. Oxford University Press, 114 Fifth Ave., New York 11, N. Y.

PUTNAM. G. P. Putnam's Sons, 2 West 45th St., New York, N. Y.

RANDOM. Random House, Inc., 20 East 57th St., New York 22, N. Y.

REYNAL. Reynal & Hitchcock, 8 West 40th St., New York 18, N. Y.

ROW, PETERSON. Row, Peterson & Co., 1911 Ridge Ave., Evanston, Ill.

SCOTT. Scott, Foresman and Company, 623 South Wabash Ave., Chicago 5, Ill.

SCRIBNER. Charles Scribner's Sons, 597 Fifth Ave., New York, N. Y.

SILVER. Silver Burdett Company, 45 East 17th St., New York 3, N. Y.

TEACHERS COLLEGE, COLUMBIA. Teachers College, Columbia University, 525 West 120th St., New York 27, N. Y.

Films

The films mentioned in this Manual are produced and distributed by Encyclopaedia Britannica Films, Inc., 20 N. Wacker Drive, Chicago, Illinois. Other educational films are available, produced and distributed for sale or rental by a number of agencies. These films are listed and classified, with brief descriptions, in a monthly cumulated catalogue, *Educational Film Guide*, compiled by Dorothy E. Cook and Eva Rahbek-Smith, and published by The H. W. Wilson Company, 950–972 University Avenue, New York 52, N. Y.

There is, of course, a considerable range in the effectiveness of films, and no film should be used in the classroom on the basis of title or brief description only. The teacher should become familiar with the content of the film and its suitability for classroom instruction before it is secured. In the case of films produced to illustrate industrial products or processes, one should scrutinize them for any possibly objectionable advertising.

Large, excellent photographs, depicting a wide variety of subjects, comprise the set entitled *Visualized Curriculum Series*. This set is put out by the Creative Education Society, Mankato, Minn.

PRINTED IN THE UNITED STATES OF AMERICA

Date Due
